MATHEMATICS CLASSROOM ACTIVITIES
OF SELECTED EAST ASIAN AND NON-ASIAN COUNTRIES
FROM THE VIEWS OF TEACHERS AND STUDENTS

A Thesis

by

JIN HEE LEE

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2012

Major Subject: Curriculum and Instruction

Mathematics Classroom Activities of Selected East Asian and Non-Asian Countries

from the Views of Teachers and Students

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Approved by:

Chair of Committee,	Yeping Li
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ABSTRACT

Mathematics Classroom Activities of Selected East Asian and Non-Asian Countries from the Views of Teachers and Students. (August 2012)

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East Asian countries have achieved high levels of mathematics competency. This study investigated classroom activities of East Asian countries based on the idea that different learning experiences lead to gaps in academic outcomes.

The main purposes of this study were: (1) to identify the features of classroom activities in the four East Asian countries of Chinese Taipei, Hong Kong, Japan, and South Korea and the two non-Asian countries of Hungary and England, (2) to determine whether or not there are predominant features of classroom activities shared in East Asia, and (3) to verify whether or not the perceptions of classroom activities between teachers and students are consistent with each other.

The data was gathered from the Student Questionnaire and the Teacher Questionnaire in TIMSS 2007. Descriptive statistics and Pearson's chi-square tests were employed to examine classroom activities in the six countries. The results indicated that, compared to traditional mathematics activities, the activities related to reform mathematics were not more likely to be deemphasized in each East Asian country. Also, with respect to reformed mathematics activities, all East Asian countries did not necessarily emphasize them less than the two non-Asian countries. Furthermore, in the frequencies of all ten activities, statistically significant differences existed between all six countries as well as within the East Asian countries. Lastly, it was found that in numerous instances, there were differences in perceptions of classroom activities between teachers and students within a country.

Based on the findings, this study suggested not to regard educational practice in East Asia as traditional and to over-simplify it by the label ‘East Asian style.’ However, further studies are needed on various aspects of classroom practice, except for classroom activities, in East Asia. In addition, this study argued that both the views of students and teachers should be considered together in the study for educational practice. Moreover, it is suggested that future studies investigate the relationships of discrepancies between teachers and students with students’ learning and achievement.

DEDICATION

To my husband Jinhyeok Jang

For his love, support, and understanding

To my parents and mother in law

For their encouragement, care, and patience

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1. INTRODUCTION

1.1 Study Rationale

Currently, many countries are greatly interested in students' academic development and are making efforts to enhance their competence. The reason is that academic skills or educational outcomes are important in terms of individual welfare, as well as society in general (Rivera-Batiz, 1992). Furthermore, the National Academy of Science (NAS, 2007) stressed that improving U.S. student achievement in mathematics and science is an overriding matter for the U.S. to enhance national competitive power in the world.

Unfortunately, although countries have concerns and make diverse efforts for their students' academic achievement, it is not likely that the outcomes of performance will be the same to every nation. Stevenson and Stigler (1992) regretted that "we [America] pour more money into our schools, but we don't see a corresponding improvement in quality" (p. 13). As a result, the variances of achievement as educational output must occur in international assessment, and it is taken for granted that distinction from low achievement to high achievement exists (e.g., the results from Trends in International Mathematics and Science Studies [TIMSS] and Program for International Student Assessment [PISA]).

It is important to identify similarities and differences in educational practices and to understand the different traditions underlying the different practices in terms of

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achievement gaps between countries (Lee, 1998; Leung, 2006). Among educational practices, examining classroom practice appears to be priority because the classroom is the predominant place where the teaching-learning process takes place (Creemer, 1994). In this respect, the classroom can be considered as a practical place to seek explanations and consequences to examine the differences and similarities in curriculum, teaching practice, and student achievement within and across nations (Clarke, 2004). More specifically, an analysis of mathematics activities in the classroom can help with understanding teaching and learning (Shimizu, Kaur, Huang, & Clarke, 2010). Thus, instruction is a significant area in international studies because different types of learning experiences that students have from country to country might lead to different achievement levels (Mullis & Martin, 2007).

Comparative studies benefit different countries by reviewing explanations for similarities and differences, which are found by comparing teaching and learning of mathematics in various educational systems (Pepin, 1997, as cited in Kaiser, Hino, & Knipping, 2006). Through comparative studies, teachers can seek better choices for teaching and learning by applying new approaches for instruction (An, 2004). Also, policy makers from different countries have opportunities to learn from one another (Shen & Pedullar, 2000). Furthermore, these kinds of studies bring attention to problems that are being taken for granted (Romberg, 1999) and gives teachers opportunities to reflect on conventional ways to teach in their own countries (An, 2004). In this respect, the analysis of the data from international assessments, such as TIMSS and PISA, should provide information and lessons to uncover evidence relevant to national policy and practice, but not just provoke the “horse race appeal”, focusing on test scores and ranking (Loveless, 2007).

In terms of culture and nation, there is a distinction between characteristic patterns in which curriculum and pedagogy interweave within the classroom (Cogan & Schmidt, 1999). Further, the differences of how students learn in classrooms are strongly related to the gaps of academic achievement from country to country (Stevenson & Stigler, 1992). Based on this rationale, this study investigates classroom activities of mathematics lessons from different countries thus how differently students learn mathematics in classrooms is observed. In addition, it could be an opportunity to confirm whether or not the differences are influenced by nations or cultures, or not. This study might serve as a foundational understanding and a look at developing educational practices for mathematics learning in different countries. Moreover, it can be the starting point to close the gaps of mathematics achievement.

1.2 Study Purpose

This study investigates the patterns of instructional activities in East Asian and non-Asian countries using TIMSS 2007 questionnaires with the several purposes. First, this investigation is expected to identify characteristics of classroom activities and to serve as a clear picture describing classroom practice in four different East Asian countries: South Korea, Japan, Chines Taipei, and Hong Kong. In addition, classroom activities in non-Asian countries, England and Hungary, will be examined to clearly determine whether East Asian countries strongly share their own common classroom practice in mathematics lessons, which is rarely observed in non-Asian countries. The reason why Hungary and England are selected as non-Asian countries for comparison and contrast with East Asia is that these two countries were placed on the top achieving Western countries in TIMSS 2007. Lastly, this study will verify whether or not the perceptions of classroom activities between students and teachers are consistent with each other. This could be the evidence whether or not considering the two standpoints of teachers and students is important.

Specifically, this research will address the following questions:

1. What are the features of classroom activities of the six countries in terms of the devoted time? Is the classroom practice of the selected East Asian countries inclined to be traditional rather than reform? Also, is the classroom practice in the two non-Asian countries close to reform mathematics?
2. With respect to activity frequencies, are the perceptions between teachers and students within a country in agreement? If not, are their discrepancies trivial or large?
3. Do the four East Asia countries show similarities in terms of the frequency of a classroom activity? If so, are the patterns rarely observed in the two non-Asian countries? Also, is a country in East Asia similar to a country in non-Asia rather than other East Asia countries with respect to the frequency of a classroom activity?

1.3 Study Significance

This study is significant in several ways. First, examining classroom practices of the highest achieving countries in East Asia itself is important. The reason is that the classroom is regarded as the nucleus of student learning, and all contributing factors for academic outcomes can be found in classroom (Webster & Fisher, 2000). East Asian students have achieved significantly high levels of mathematics competency (Gonzales et al., 2008; Stevenson, Chen, & Lee, 1993; Stevenson & Stigler, 1992). This study will identify similarities and differences in classroom activities of mathematics and implicit patterns of teaching and learning that underlie those activities in East Asian countries. Common successful experiences in East Asian countries can serve as an example for other countries so they can apply them to their educational systems. Also, the recognition of the differences between East Asian countries can give them an opportunity to learn from one another.

Second, this comparative study within East Asian countries and between East Asian and non-Asian countries can reveal whether or not there are trends between classroom practices for the 8th grade mathematics lessons. Findings from previous studies indicated that there are cultural differences in classroom practice and instructional strategies (Hoang, 2009). Although mathematics and science are less likely to be embedded culturally unlike history and language, strong cultural components also appear in teaching of these subjects (Schmidt et al., 1996). Moreover, the term "East Asian" in teaching and learning has used to differentiate from those in the West. However, it is necessary to make certain whether there are general patterns of instructional activities in East Asian countries to justify using the term. Thus, this study can help to make the equivocal representation explicit.

The methodology in this study is also significant. This study, which utilizes large-scale data of TIMSS 2007, can make up for the lack of data used in previous studies. Previous studies tended to examine only minimal samples of teachers, students, and schools. For instance, in Lee's comparative study (1998), 10 schools were selected in one metropolitan city of each country, China, Japan, and Taiwan, and two first grade and two fifth grade classrooms were chosen randomly. In other words, Lee employed 20 classrooms as samples for each grade to describe educational practice of the particular country. It is hard to say that several samples of teachers and classrooms located in specific areas represented well in particular countries and indicated predominant classroom practice. On the contrary, this study was performed using the TIMSS 2007 survey data, which provide "accurate and efficient estimates of national student populations" (Joncas, 2008, p.77) through their own sample design. In other words, TIMSS 2007 have its own sample designs for selecting schools and classes and adequate sample sizes of students, classes, and schools (Joncas, 2008).

Last but not least, this study examines the identical information about instructional activities from both students and their teachers. A teacher and students are nested in a same space, a classroom, and teaching and learning takes place there at the same time. Thus, theoretically, two sides' answers about what happens in the classroom must be consistent with each other. However, not all is the case. For instance, Brok, Bergen, and Brekelmans (2006) investigated the divergence and convergence between students and teachers' perceptions about teachers' instructional behaviors such as control of student learning, classroom management and clarity. The result indicated that two sides' answers always didn't show agreement, and in some cases considerable differences occurred between them. Thus, they warned against using only the perceptions of teachers or students which may bring out "a one-sided and incomplete view" (Bergen & Brekelmans, 2006, p.11). In this respect, it is necessary to consider two responses from students as well as a teacher in order to figure out predominant instructional features accurately. This examination should be more reliable than others previous studies that depended on only student or only teacher responses.

1.4 Study Limitation

There are two main limitations in this study. First, there are the disadvantages of using a questionnaire. Basically, questionnaires are impersonal, so it may be difficult to understand answers accurately. Because questionnaires are standardized, it is possible that respondents misinterpret questions. Survey items could be interpreted differently from investigators' intention (Hamilton & Martinez, 2007). Furthermore, it is possible that words and concepts used in questionnaires are understood in different ways between different cultures as well as even teachers in one nation (Neubrand, 2006). Thus, the format of questionnaire design makes researchers difficult to gather information about complex issues and opinions in depth and detail.

Second is the limitation about TIMSS data. "The TIMSS tests were designed to ensure the validity of cross-country comparisons, but not for sensitivity of instructional practice" (Hamilton & Martinez, 2007, p. 133). Although TIMSS is technically sophisticated by considerable effort of many dedicated and talented people, it provides not all, but partial answers of complex educational situations (Kilpatrick, 2009). Thus, the survey data from TIMSS do not provide a complete picture of instructional activities at all (Hamilton & Martinez, 2007).

2. LITERATURE REVIEW

In this section, I reviewed previous studies related to instructional activities in mathematics classrooms. First of all, activities in mathematics classrooms were looked over under two categories, traditional mathematics and reform mathematics. Second, classroom practices in East Asian were also reviewed. Last, discrepancies between students' and teachers' perceptions of instruction were investigated.

2.1 Classroom Activities in Mathematics Lessons

Classroom activities are actions structured by what is taught through the use of tasks in particular and by instructional context in general (Stodolsky, 1988). Tasks manage students' attention to specific content of learning as well as designate ways for students to process information (Doyle, 1983). Thus, "a mathematical task is defined as a classroom activity, the purpose of which is to focus students' attention on a particular mathematical idea" (Stein, Grover, & Henningsen, 1996, p. 460). In other words, a mathematics task is what students are asked to do during mathematical lessons (Mason & Johnston-Wilder, 2006). In mathematics lessons, students learn what teachers plan through involvement in mathematical tasks, which help to establish foundational knowledge and perception of mathematics (Kaur, 2010).

Appropriate tasks in mathematics lessons can contribute to successfully achieving instructional goals (Kaur, 2010) because meaningful tasks inspire students' motivation for learning and lead them to think about mathematical concepts and procedures (National Council of Teachers of Mathematics [NCTM], 1991). In this respect, what and how teachers assign tasks to students in their instructions can determine how students master what is taught (Shimizu et al., 2010). Thus, the differences in academic activities for learning can be a key reason for the achievement gaps between countries (Stigler, Lee, & Stevenson, 1987).

Hiebert and Grouws (2007) insisted that "different approaches of teaching provide different opportunities to learn, in turn, yield different kinds of learning" (p. 380). Therefore, it is no wonder that educators need to seek proper instructional methods, which encourage learning. In the U.S., the debate over what and how to teach and learn in mathematics grew into the "math war": basic or traditional mathematics versus reform mathematics (Van de Walle, 1999). These conflicting perspectives regarding mathematics education emphasize specifically what and how students learn in mathematics lessons (Hiebert & Grouws, 2007; Van de Walle, 1999). In this respect, observation of lesson activities in which teachers ask students can be an opportunity to understand more deeply mathematics education, which underlies their educational practice.

2.1.1 Traditional mathematics activities

Traditional mathematics emphasizes the importance of "the basics" in mathematics (Van de Walle, 1999). This position pursues the goal, "skill efficiency", which refers to accurate, smooth and rapid execution of mathematical procedures, excluding the flexible use of skills or their adaption to fit new situations (Gagne, 1985).

Thus, in traditional mathematics, the activity regarding arithmetic or computation is predominant through finding answers to questions and memorizing formulas (Van de Walle, 1999), so it is labeled “drill and kill” (Hamilton & Martinez, 2007). Askew, Brown, Rhodes, William and Johnson (1997) named transmission teachers when teachers focus on learning of an individual activity, which consists of memorization of mechanical skills.

Also, mathematical content, namely what students should know in mathematics, is emphasized in learning (Van de Walle, 1999). TIMSS 2007 collected information on how frequently content-related activities are conducted as the following: (1) practice addition, subtracting, multiplying, and dividing without using a calculator, (2) work on fractions and decimals, (3) use knowledge of the properties of shapes, lines and angles to solve problems, (4) interpret data in tables, charts, or graphs, and (5) write equations and functions to represent relationships (Erberber, Arora, & Preuschoff, 2008). The first two activities are related to number content, the third one is related to geometry content, the fourth one is related to data and chance content, and the last one is related to algebra content (Mullis, Martin, & Foy, 2008).

However, it is hard to conclude that all content-based activity is inclined to traditional instruction because mathematical contents have different features in terms of learning. The five content standards were produced by NCTM (2000): number and operations, algebra, geometry, measurement, and data analysis and probability. Among them, the primary learning goals related to algebra, geometry, measurement, and data analysis and probability focus on application, analysis, or exploration based on understanding, rather than rote learning (see Appendix A). Thus, in Hamilton and Martinez's (2007) study, whereas the two activities related to number content were regarded as traditional instructional practice, other activities related to algebra and data analysis contents were treated as reform-oriented instructional practice in TIMSS 2003.

2.1.2 Reform mathematics activities

In contrast to traditional mathematics, reform mathematics stresses mathematical power through problem solving, communication, reasoning, and connections (Van de Walle, 1999). It is de-emphasized in reform mathematics for teachers and students to be concerned with specific methods leading to correct answers (Quirk, 2005). Stiff (2001), who was a president of NCTM, wrote as below:

> Reform-minded teachers pose problems and encourage students to think deeply about possible solutions. They promote making connections to other ideas within mathematics and other disciplines. They ask students to furnish proof or explanations for their work. They use different representations of mathematical ideas to foster students' greater understanding. These teachers ask students to explain the mathematics (para. 3).
>
> Their students are expected to solve problems, apply mathematics to real-world situations, and expand on what they already know (para. 4).

Hamilton and Martinez (2007) measured exposure to reform-oriented practice using TIMSS 2003. In their study, based on other studies about reform mathematics, the seven activities were identified with reform-oriented approaches: (1) work on problems with no immediately obvious method of solution, (2) work together in small groups, (3) relate what students are learning in mathematics to their daily lives, (4) explain [students'] answers, and (5) decide on [students'] own procedures for solving complex problems, (6) interpret data in tables, charts, or graphs, and (7) write equations and functions to represent relationships.

This standpoint emphasizes conceptual understanding, rather than procedural skills. In conceptual understanding in learning, the following activities for construction of relationships among mathematical facts, procedures, along with ideas are involved: discussion of mathematical meaning underlying procedures and asking questions about various strategies for solutions. In addition, students are encouraged to "struggle" with mathematical ideas intentionally and consciously (McNaught & Grouws, 2007). This means stimulating students to construct deep understanding through mathematical problematic situations, not simply presenting memorized information or practicing how to demonstrate (Hiebert & Grouws, 2007).

In addition, reform mathematics emphasizes student-centered instruction (Hamilton & Martinez, 2007). In the environment of student-centered learning, students, not a teacher, are at the center of an active role. There are learnings through different approaches which fit the SCL criteria: active learning, collaborative learning, problem-based learning, cooperative learning, inquiry-based learning, team-based learning, small groups learning, peer instruction, project-based learning, and others (Froyd & Simpson, 2010). Aypay, Erdogan, and Sozer (2007) utilized the following indicators as student-centered classroom activities among the 26 variables in TIMSS 1999 data: (1) work on a project, (2) work from worksheets on [students'] own, (3) solve problem with everyday life-things, (4) work together in pairs and small groups, (5) discuss practical problems related to everyday life, (6) discuss [students'] completed homework, (7) do experimental or practical investigations, and (8) begin a new topic by working together in small groups on a problem or project.

Table 1
Classification of Classroom Activities in TIMSS 2007

Classroom activity	Traditional mathematics	Reform mathematics	mathematical content
Practice adding, subtracting, multiplying, and dividing without using a calculator	x		Number and operation
Work on fractions and decimals	x		Number and operation
Solve problems about geometric shapes, lines, and angles		x	Geometry
Interpret data in tables, charts, or graphs		x	Data analysis and probability
Write equations and functions to represent relationships		x	Algebra
Memorize formulas and procedures	x		-
Explain students' answers		x	-
Relate what students are learning in mathematics to their daily lives		x	-
Decide on our students' procedures for solving complex problems		x	-
Work together in small groups		x	-

Table 1 shows the classroom activities in the questionnaire from TIMSS 2007, which are investigated in this study. They are placed under the categories of traditional or reform mathematics based on the previous studies mentioned above (e.g., Aypay et al., 2007; Hamilton & Martinez, 2007; Stiff, 2001; Van de Walle, 1999).

However, traditional and reform mathematics are not in opposition to each other on the learning continuum for mathematics (Van de Walle, 1999). Although learning computational skills and developing understanding in mathematics have frequently been discussed as two different extremes, they are not thought of as opposite to each other, but as two sides of the same coin (Carpenter et al., 2006). In the U.S., while a number of mathematical reforms insisted change in instructional approaches promoting mathematical thinking throughout the 1990s, certain types of basic skills and factual knowledge were alienated in mathematics education (Hamilton & Martinez, 2007; Hartocollis, 2000). As a result, recently, the lack of computational skills is emerging as one of major issues in U.S. mathematics education (Hartocollis, 2000). Bielsker, Napoli, Sandino, and Waishwell (2001) believed that U.S. students did not master basic skills in mathematics, and this deficiency had affected their ability to solve more advanced mathematical problems; Memorization of math skills is necessary so that students have the strong background to go beyond simple calculation.

With regard to teaching strategies, there are not correct answers, which productively fit every situation universally; different situations need different strategies (Hayes, Lingard, & Mills, 2000). Therefore, “development of skills and conceptual understanding is not a simple dichotomy” (McNaught & Grouws, 2007, p. 6). Educators and researchers must be wary of simplifying teaching and learning by this dichotomy between traditional mathematics and reform mathematics when capturing and interpreting the subtle characteristics of classroom practice (Hiebert & Grouws, 2007).

2.2 Classroom Activities in East Asia

Culturally and nationally, there are distinct patterns in which curriculum and pedagogy interweave within classrooms (Cogan & Schmidt, 1999). According to culture, ways to teach and learn in classrooms are different because the social, economic, and political forces, which exist in particular culture, influence teaching and learning (Kawanaka, Stigler, & Hiebert, 1999). For instance, TIMSS developed two supplementary video studies in 1995 and 1999 arguing that national teaching patterns represent educational practices (Hiebert et al., 2003; Stigler, Gonzales, Kawanaka, Knoll, & Serrano, 1999). As a result, Stigler and Hiebert (2004) viewed that within a culture lessons were designed by teachers who share a common mental picture regarding teaching, so "teaching is a cultural activity" (p. 86).

The unique features of mathematical education in East Asian countries reflect the region's cultural values. Previous studies often described the East Asia's teaching style as traditional compared with Western countries (Leung, 2001), so people have stereotyped views about Asian education such as "Asian teaching methods stress rote learning, relying on endless, mindless drill of basic skills" (Stevenson & Stigler, 1992, p. 21). In other words, mathematical contents and the procedures or skills to deal with the contents are emphasized in East Asian classroom. Thus, memorization and repeated practice seem to be frequently accepted ways of learning, which are sometimes criticized as rote learning (Leung, 2001). In contrast, Lee's study (1998) concluded that "reform ideas about mathematics teaching are actualized in the East Asian classrooms" (p. 73). Specifically, students in Japan, Taiwan, and China are frequently engaged in verbal explanations, and they often were encouraged to do activities to facilitate in-depth understanding of mathematical concepts in their lessons. Also, teachers asked students to solve problems in various ways and elaborated on students' answers through discussions (Lee, 1998). As these examples, there exists inconsistency in how to teach and learn in mathematics lessons within East Asian countries.

Recently, the use of terms such as 'Asian' and 'East Asian' as a way to describe the regional characteristics of classroom practice has been problematized (Huang & Leung, 2004). Wong (2009) warned that these simple classifications of the East compared to the West were erroneous. Also, Wang and Lin (2005) argued "ambiguous cross-national categorizations of East Asian students from Japan, China, Korean, and other East Asian regions and countries" (p. 4) should not be used. Li and Shimizu (2009) also expressed their concern about over-generalized teaching practices in East Asia. For instance, Stevenson and Stigler (1992) investigated Japanese, Taiwanese, and Chinese education in order to discover ways to reveal and solve the American educational system. In their book, they used the term "Asian" to describe and explain educational situations in Japan, Taiwan, and/or China. Here are unclear questions: Are three countries representative of the whole Asian educational system? In other words, can the term 'Asia (n)' represent each individual Asian country? Also, what does the expression ‘Asian’ tell us regarding teaching and learning more concretely?

It is necessary to be clear whether or not ‘Asian’ or ‘East Asian’ can be used to describe overall features of educational practice in East Asian countries. Of course, more culturally common features should exist within East Asian countries than between the East and the West because of the common cultural backgrounds such as Confucian, which have influenced education and been shared for a long time. Although East Asian counties are geographically located closely and belong to the same Confucian cultures, there are different characteristics of teaching and learning between them (Wang & Lin, 2005). For instance, Japanese lessons from the TIMSS video study were not consistent with the typical teaching and learning in East Asia (Lopez-Real, Mok, Leung, & Marton, 2004). The mathematical work, on average, was a “balance” in Japanese classrooms (Stigler & Hiebert, 1999):

> Students sometimes, but not always, do creative mathematical work by inventing new methods and presenting them to the class. At other times, teachers control the mathematics – lecturing, demonstrating, and asking students to memorize (p. 71).

Lin and Li (2009) explained classroom teaching and learning in Taiwan as, differing from the stereotype of Asian learning:

> The lesson started by providing students contextual problems that relate to students’ daily experience and prior knowledge....Students were encouraged to explain and justify what they discovered. Students were given the opportunities

> for comparing and contrasting various solutions in terms of mathematically significant ideas (p. 376).

Mok and Morris (2001) described the features of mathematics lessons in Hon Kong as extensive use of group work and questioning, rarely direct explication of textbook content, and many specific and skill-based tasks. Additionally, they pointed out that the revealed features were different from teaching and learning in Japan. Hiebert and Stigler (2004) also found that there was a great deal of variation in the relative emphasis on conceptual problems in comparison with problems for skill efficiency; 54 % of whole problems was conceptual problems in Japan, but only 13 % was related to conceptual problems in Hong Kong. Also, Huang and Leung (2004) insisted that the characteristics of mathematics learning in Hong Kong could not be regarded as rote and passive learning and there were differences, as well as similarities, in teaching and learning between China and Hong Kong. Therefore, one must be careful in using the term "Asian" for teaching practices because there are the variations within Asian contexts (Mok & Morris, 2001).

In fact, diversity of classroom activities and practice can be also observed within a single country (Laborde, 2006). For instance, differences of teaching and learning mathematics in classrooms (e.g., how teachers teach, how teachers organize learning activities) were found between rural and urban regions in China (Ma, Zhao, & Tuo, 2004). There are, of course, similar aspects of instructional strategies in mathematics lessons around the world. TIMSS 2003 reported that predominant activities were observed such as teacher lecture, teacher-guided student practice, and students working on problems on their own (Mullis & Martin, 2007). Stevenson and Stigler (1992) warned that it is dangerous to have biased views of oneself as well as others regarding teaching and learning, preventing efforts to solve the problems or making wrong generalizations. Thus, it is necessary to confirm whether or not the national or cultural patterns of learning and teaching exist in East Asia to make clear justifications for distinction.

2.3 Students' and Teachers' Perceptions of Instruction

Students learn what teachers plan during their lessons (Kaur, 2010). Therefore, in order to accurately observe what is taking place in the classroom, it is necessary to consider the both the opinions of students as well as teachers (Biemans, Jongmans, de Jong, & Bergen, 1999; Brok et al., 2006). However, there are previous studies, which considered only teachers or students, but not both of them. For instance, according to Neubrand's review in his study (2002), two TIMSS Video Studies focused on teaching practices, because the investigators thought classroom events were regarded as "events of teaching" (p. 292). Therefore, he insisted that all documents about the TIMSS video studies were related to what and how teachers did, but what and how students did were not in the central focus. Also, in Hoang's study (2009), only a student questionnaire was used to collect data regarding classroom instructional activities: teaching strategies for new mathematics topics, homework activities, and typical classroom activities in order to determine if there was a relationship between learning and instruction in mathematics achievement.

However, the awareness of instruction between teachers and students is not always in agreement. Biemans et al. (1999) investigated teachers' instructional behaviors through the *Questionnaire of Instructional Behavior* answered by teachers and their students. Interestingly, teachers tended to estimate their own instructional behaviors higher in all respects (i.e., marking closer to almost always than hardly, or marking closer to very much than not) than their students did. Brok et al. (2006) investigated how much convergent and divergent teachers' and students' perceptions are and confirmed that there were differences between the perceptions of the two sides. As another example, Hamilton and Martinez (2007) examined the relationships of the responses between students and their teacher with respect to instructional practice. Their study demonstrated differences in responses between teachers and students depending on instructional styles.

The reason for the discrepancy might be that teachers are more likely to understand nature and goals of instructions they are in charge of, or to recognize socially desirable answers (Hamilton & Martinez, 2007). Brok et al. (2006) mentioned, based on previous studies, that higher teacher than student perceptions may be the result of teacher's "wishful thinking." According to the result of Hamilton and Martinez (2007), teachers tended to response more frequently using reform-oriented instructional practices than their students. Contrarily, regarding traditional instructional aspects, students reported more frequent use of traditional instructional practices in classrooms than their teachers. Therefore, it is possible that teachers are not able to assess their own instruction realistically (Biemans et al., 1999).

In addition, Brok et al. (2006) found that the degree of discrepancy was related to the teaching style. For instance, teachers who had teacher-centered instruction showed less divergence in terms of instructional behaviors regarding clarity and control on students than teachers with other styles. Therefore, it is important to provide students' eyes, in addition to teachers' perspective, in order to yield more valid information (Biemans et al., 1999) as well as avoiding reporting incomplete views (Brok et al., 2006).

3. METHODOLOGY

A quantitative research approach based on the data from TIMSS 2007 was selected to understand classroom activities in mathematics lessons. Also, another major effort was to make cross-national comparisons.

TIMSS is designed to provide internationally comparative information about educational achievement for the purpose of improving teaching and learning in mathematics and science (Mullis et al., 2008). Since 1995, TIMSS has conducted a regular 4-year cycle to measure trends in mathematics and science achievement at the 4^{th} and 8^{th} grade levels in widespread participating countries in the world (e.g., about 425,000 students from 59 countries in TIMSS 2007). In every cycle, TIMSS has also collected background information about the learning contexts such as educational systems, school organizational approaches, and instructional practices (Foy & Olson, 2009). "Learning takes place within a context, and not in isolation," so it is significant to perceive the contexts where students learn (Mullis et al., 2005, p.81).

TIMSS 2007, as the fourth assessment, involves five broad areas in which information is collected: curriculum, schools, teachers and their preparation, classroom activities and characteristics, and students. The category of classroom activities and characteristics involves the information related to the curriculum topics, the pedagogic approaches used, the materials and equipment available, and the learning conditions such as class size and composition (Mullis et al., 2005). The data about the aspects of the implemented curriculum were collected via questionnaires completed by the students themselves and by their teachers and principals (Mullis et al., 2008).

3.1 Population and Sample

This study investigated students in the eighth year of schooling and their teachers in the countries, South Korea, Japan, Chinese Taipei, Hong Kong, and Hungary, and students in the ninth year of schooling and their teachers in England. TIMSS typically assesses students in the eighth grade. However, to avoid testing very young children, TIMSS has guidelines, which defines the average age of the students assessed should not be below 13.5 years old for the eighth grade. If a country corresponds to this guideline, students must be tested at the next higher grade, that is, the ninth grade. Following this guideline, England tested students in ninth year of schooling, because schooling in England begins at earlier age than others. The range of the average age of students in the countries for this study is from 14.2 to 14.6 years (Mullis et al., 2008).

The TIMSS 2007 employed two stages of sample design to ensure that participating samples of schools and students were representative for its population in each country. At the first stage of sampling, schools were selected with consideration of school type and location, and at the second stage, one or more classes were chosen randomly from the target grade in the sampled schools. TIMSS requires that the sample size of students should be at least 4,000 students to provide a large enough sample sizes for analyses, which need to break down all student population into many subgroups. In addition, in order to productively conduct analyses at the classrooms and schools levels, each country is required to sample at least 150 schools per targeted grade (Joncas, 2008).

However, teachers who participated in TIMSS were not nationally representative samples because they were just teachers who taught the selected representative samples of students (Foy & Olson, 2009).

Table 2 contains the initial numbers of sampled students and teachers in the six countries related to this study from TIMSS 2007. Also, the numbers of the final samples of students and their teachers for this study after deletion of missing data are presented.

Table 2
Sample Numbers of Countries

		Chinese Taipei	Hong Kong	Hungary	Japan	South Korea	England
Teacher	Final data	143	135	260	212	233	220
	Missing data	9	10	29	4	10	15
	Total	152	145	289	216	243	235
Student	Final data	3745	3345	3798	4142	4146	3714
	Missing data	301	125	313	170	94	311
	Total	4046	3470	4111	4312	4240	4025

3.2 Instrument

This study was performed using the data of TIMSS 2007 Student Questionnaire and Teacher Questionnaire. From the questionnaires, the ones asking instructional activities were selected. Teachers were asked how they allotted their time to instructional activities in mathematics. This provides useful information about their predominant pedagogies in mathematics classrooms. Also, students were also asked to report the frequency with which they do learning activities in mathematics lessons

(Mullis et al., 2005). This study selected the identical items which are involved in both of the questionnaires to compare responses of students and teachers.

3.2.1 Student questionnaire

In TIMSS 2007, each student in the sampled class was asked to complete the Student Questionnaire (Mullis et al., 2008). From the 21 questions in the Student Questionnaire, this study selected one that addresses classroom activities in mathematics lessons (see Appendix B). However, among these17 items in the question asking about classroom activities, this study used 10 items, which were identical with those in the Teacher Questionnaire. Specifically, the selected items for this study in the question were;

How often do you do these things in your mathematics lessons?

a. We practice adding, subtracting, multiplying, and dividing without using a calculator
b. We work on fractions and decimals
c. We solve problems about geometric shapes, lines and angles
d. We interpret data in tables, charts, or graphs
e. We write equations and functions to represent relationships
f. We memorize formulas and procedures
g. We explain our answers
h. We relate what we are learning in mathematics to your daily lives
i. We decide on our own procedures for solving complex problems

j. We work together in small groups

On each of the items, a four-point likert type scale was used. In other words, students answered one of the four categories with respect to the frequency of each activity: every or almost every lesson, about half the lessons, some lessons, or never.

3.2.2 Teacher questionnaire

In TIMSS 2007, each mathematics teacher who taught students assessed was asked to complete the Teacher Questionnaire (Mullis et al., 2008). From the 34 questions, this study selected one related to classroom activities in mathematics lessons (see Appendix B). However, like the Student Questionnaire, this study used 10 items, which were identical with those in the Student Questionnaire. Specifically, the selected items for this study in the question were;

In teaching mathematics to the students in the TIMSS class, how often do you usually ask them to do the following?

a. Practice adding, subtracting, multiplying, and dividing without using a calculator
b. Work on fractions and decimals
c. Use knowledge of the properties of shapes, lines and angles to solve problems
d. Interpret data in tables, charts, or graphs
e. Write equations and functions to represent relationships
f. Memorize formulas and procedures

g. Explain their answers

h. Relate what they are learning in mathematics to their daily lives

i. Decide on our their procedures for solving complex problems

j. Work together in small groups

On each of the items, a four-point likert type scale was used. In other words, teachers marked one of the four categories with respect to the frequency of each activity: every or almost every lesson, about half the lessons, some lessons, or never.

3.3 Data Collection

TIMSS 2007 data for this study were collected in 2006 through 2007 along with mathematics and science assessment, and the period for data collection varied between countries (see Table 3).

Table 3
Period for Data Collection

		Month					
		Chinese Taipei	Hong Kong	Hungary	Japan	South Korea	England
Year	2006	-	-	-	-	12	-
	2007	5, 6	5, 6, 7	3, 4	3	-	5, 6, 7

The data used for this study were downloaded from the TIMSS 2007 International Database (http://timss.bc.edu/timss2007/idb_ug.html). To conduct statistical analyses, Statistical Package for the Social Sciences (SPSS) system files were created by the International Association for the Evaluation of Educational Achievement (IEA) International Database (IDB) Analyzer software. The IEA IDB Analyzer furnishes "a user-friendly interface to easily merge the various data file types of the TIMSS 2007 database" (Foy & Olson, 2009, p. 7). The IDB Analyzer is available for download and can be installed from the IEA website (http://www.iea.nl/data.html). All information and explanation about the data were obtained from the code book file and the book, *TIMSS 2007 User Guide* (Foy & Olson, 2009).

3.4 Data Analysis

Missing data for some variables and some cases often exist. The way to deal with missing data can have an influence on the results of analyses. One conventional method regarding missing data is deletion, which leads to the loss of statistical power when the deleted part of the sample is large (Allison, 2001). Nevertheless, this study conducted a listwise deletion, which means missing data in one or more variables are eliminated from the analysis (Allison, 2001). The disadvantage of deletion is not too large because TIMSS has large-scale data, and the missing cases in this study account for about 6.8% on average (see Table 2).

After handling the above work, two kinds of statistical tests were generated: (1) descriptive statistics and (2) Pearson's chi-square test (χ^2). Descriptive statistics describe and present data such as summary frequencies (Cohen, Manion, & Morrison, 2011). Descriptive statistical analysis was conducted to determine the characteristics of classroom activities in the selected countries. In other words, how often an activity happens in mathematics lessons of each country were observed by percentages of the four response categories to which students and teachers responded.

The items about classroom activities in the TIMSS 2007 questionnaire employed a four-point likert scale. In a likert-type scale, which is often used for asking opinions and attitudes (Cohen et al., 2011), respondents are asked to rate their answers on a given discrete category of agreement or quality such as ranged from strongly disagree to strongly agree (Gorard, 2001). A likert scale is often utilized in parametric analysis despite ordinal scale (Gorarad, 2001), but if researchers want to use the likert scale as parametric statistics such as computing mean, it is necessary that category descriptors are equal-sized gradations (Friedman & Amoo, 1999). However, in this study non-parametric tests are more appropriate than parametric test (Gibbons, 1993) because it is hard to judge that the four categories in TIMSS for this study - (almost) every lesson, about half the lessons, some lesson, and never - are considered as equal intervals.

The chi-square test, which is a non-parametric test, is a “test of difference” and “addresses the notion of statistical significance” (Cohen et al., 2011, p. 651). This study conducted the chi-square test for a goodness-of-fit to examine whether the response deviations are larger enough than chance so that the conclusion is that the responses regarding an activity’s frequency were not random. In addition, the chi-square test for independence was conducted for two reasons. First, it was examined whether there is a significant difference between students and teachers within a nation in terms of the responses regarding an activity’s frequency. Second, it was also examined whether there is a significant association between the countries and the responses with regard to an activity's frequency. In order to easily understand the perceptions about devoting time of the activities, the four response categories were transferred into the two categories: a "frequently" category by combining the two categories of every lesson and about half the lessons and an "infrequently" category by combining the two categories of some lessons and never.

The chi- square test is based on certain assumptions under which it is important to operate the chi-square test fairly: categorical data, randomly sampled population, mutually independent categories, discrete data, and at least 80% of cells with five or more expected count (Cohen et al., 2011). The TIMSS data used in this study fit these assumptions. The chi-square tests were performed using SPSS version 20, based on a .05 level of statistical significance.

In addition, large scale data, such as TIMSS data, can easily reach statistical significance, which does not tell very much about practical significance (Howell, 2009). Therefore, it was necessary to ascertain the practical significance of statistical significance through an effect size in order to report and interpret appropriately (Trusty, Thompson, & Petrocelli, 2004). The effect sizes of the *r*-family, such as Phi or Cramer's V, are not recommended for categorized data because it is hard to meaningfully interpret them in most situations of categorical data analyses (Howell, 2009; Vacha-Haase & Thompson, 2004). For practical significance, this study used an odds ratio, which belongs to the *d*-family, based on "one or more measures of the differences between groups or levels of the independent variable" (Howell, 2009, p. 159).

4. RESULTS

The findings are reported according to two research questions in this study. The first question addresses the features of classroom activities based on teachers' and students' answers on their questionnaires. Also, the comparison of perceptions between teachers and students regarding the classroom activities is presented. In the second part, it is revealed whether or not four East Asian countries strongly share similar patterns in the classroom activities when all six countries, including two non-Asian countries, are compared.

4.1. Classroom Activities within a Country

The following figures illustrate the response of teachers and students in four categories in each country, and Appendix C describes the percentages in detail. In addition to the observation of the four categories, more general patterns of the activities are examined by the recognizable dichotomy: 'frequently' consisting of two response categories of almost every lesson and about half the lessons; 'infrequently' consisting of two response categories of some lessons and never.

In all ten activities from the six countries, the chi-square tests of goodness of fit indicated that the responses' distributions on the four categories pertaining activity frequencies were not random but greater than chance levels. Thus, regarding each activity, students as well as teachers of all six countries tended toward a particular frequency among almost every lesson, about half the lessons, some lessons, or never.

In addition, the chi-square tests (see Appendix D) of the relationship between responses on the four categories and respondents who were teachers or students indicated statistically significant differences at $p < .05$ for all ten activities from all six countries, except for only one case, the activity of memorization in Japan. In other words, overall, the responses about how often an activity occurred in mathematics lessons were different from the respondents who were students or teachers in a country.

4.1.1 Chinese Taipei

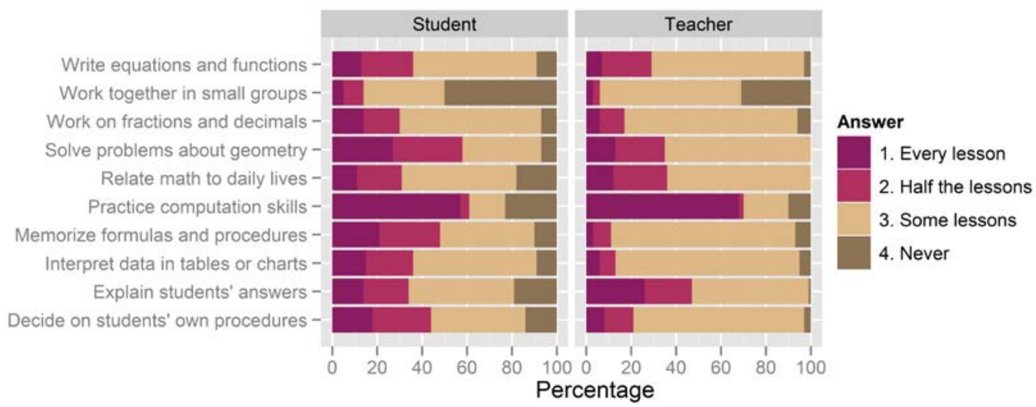

Figure 1. Responses of teachers and students in Chinese Taipei.

Teachers and students did not uniformly employ the activities related to traditional mathematics. It is evident in Figure 1 that practicing computation was mostly emphasized by both teachers and students compared to the rest of the activities. Contrarily, teachers and students showed conflicting opinions about the activity of memorizing formulas and procedures. Students placed much more emphasis on memorization than their teachers did: About 50% of students felt that they spent time memorizing in at least half the lessons whereas about 90% of teachers felt they sometimes or never involved students in memorization.

In the reform mathematics activities, while 93% of teachers felt that at least sometimes they encouraged students to explain their answers, only 20% of students felt they never explained their answered. On the contrary, the majority of teachers felt they did not strongly emphasize students' own procedure in solving complicated problems, but students felt they had placed more emphasis on this activity than teachers did. Also, while all teachers, at least sometimes felt they related mathematics to daily lives of their students, 18% of students felt that they were never involved in these kinds of activities. According to the responses, small group activities were seldom provided by teachers or used by students in their mathematic lessons. In respect to geometry and data analysis activities, which are content-related as well as reformed mathematics, large proportions of teachers answered that they sometimes or never asked students to do these activities (65% for geometry and 86% for data analysis), but students tended to emphasize them more than teachers did.

Table 4 presents general frequencies of activities in Chinese Taipei, frequently versus infrequently. There were significant differences in perceptions of activity frequencies between teachers and students except for two activities, algebraic activity and daily life-related activity. Remarkable differences were observed: Students were 7.5 times more likely than teachers to answer that memorization occurred frequently rather than infrequently; teachers were about 4 times more likely than students to perceive that the data analysis content activity happened infrequently rather than frequently.

Table 4
General Frequencies of Activities in Chinese Taipei

Activity		Frequently (%)	Infrequently (%)	Chi-square	Odds ratio (T / S)
Practice computation skills	T	70	30	4.75*	1.49
	S	61	39		
Work on fractions and decimals	T	18	83	10.16*	0.50
	S	30	70		
Solve problems about geometry	T	35	65	28.89*	0.40
	S	58	42		
Interpret data in tables or charts	T	13	87	31.84*	0.26
	S	36	65		
Write equations and functions	T	29	71	2.953	0.73
	S	36	64		
Memorize formulas and procedures	T	11	89	77.34*	0.13
	S	49	51		
Explain students' answers	T	48	52	12.00*	1.80
	S	34	66		
Relate math to daily lives	T	36	64	1.68	1.26
	S	31	69		
Decide on students' own procedures	T	22	78	28.11*	0.35
	S	44	56		
Work together in small groups	T	6	94	7.87*	0.37
	S	14	86		

* $p < .05$.

4.1.2 Hong Kong

As shown in Figure 2, teachers did not tend to emphasize the activities related to traditional mathematics including practicing computation, memorizing, and working on fractions and decimals. On average 80% of teachers sometimes or never involved students in these traditional mathematic activities, but students felt that these activities were much more emphasized the activities than did teachers.

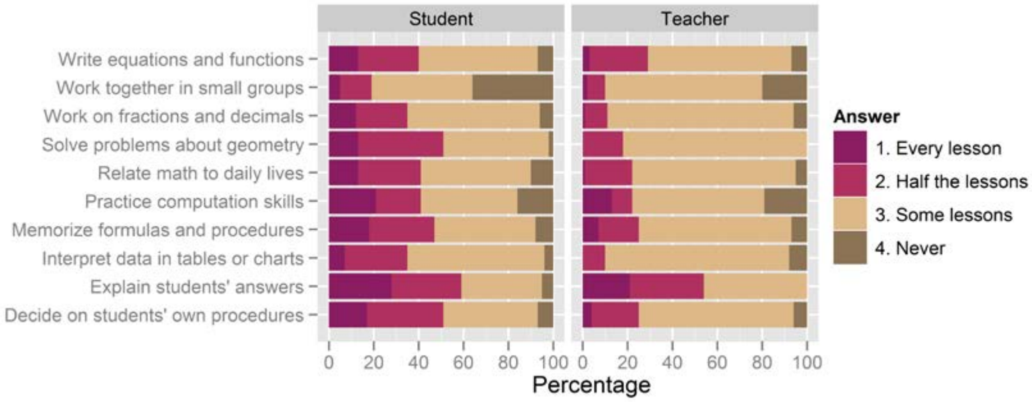

Figure 2. Responses of teachers and students in Hong Kong.

In the activities of reform mathematics, teachers as well as students seemed to most emphasize the activity of explaining students' answers compared to the rest of other activities. However, in general, teachers did not really emphasize others except for the activity of explanation compared to the traditional mathematics activities, but students tended to feel that they were more emphasized than teachers did. About 80% of teachers felt that they sometimes or never engaged in activities relating to daily lives and deciding students' own procedures, but over 40% of students felt they were engaged in these two activities in at least half of their lessons. Similarly, regarding geometry, data analysis, and algebra activities, students felt that these topics were emphasized more than teachers did. However, both teachers and students tended to deemphasize the small group activity in comparison with other activities.

Table 5
General Frequencies of Activities in Hong Kong

Activity		Frequently (%)	Infrequently (%)	Chi-square	Odds ratio (T / S)
Practice computation skills	T	22	78	18.77*	0.41
	S	41	59		
Work on fractions and decimals	T	11	89	32.36*	0.24
	S	35	65		
Solve problems about geometry	T	18	82	56.788*	0.21
	S	51	49		
Interpret data in tables or charts	T	10	90	34.23*	0.22
	S	35	65		
Write equations and functions	T	29	71	6.91*	0.61
	S	40	60		
Memorize formulas and procedures	T	24	76	26.42*	0.37
	S	47	53		
Explain students' answers	T	54	46	1.71	0.80
	S	60	40		
Relate math to daily lives	T	22	78	18.77*	0.41
	S	41	59		
Decide on students' own procedures	T	24	76	37.61*	0.31
	S	51	49		
Work together in small groups	T	10	90	7.81*	0.45
	S	19	81		

* $p < .05$.

Table 5 shows general frequencies of activities in Hong Kong, frequently versus infrequently. The perceptions of activity frequencies between teachers and students were significantly different except for one explanation activity of explanation by students. Students were more likely than teachers to answer that activities occurred frequently rather than infrequently although there were differences in degree. Especially, in the activities about fractions and decimals, geometry, and data analysis, students were

4 or 5 times more likely than teachers to answer that these activities were done frequently rather than infrequently.

4.1.3 Hungary

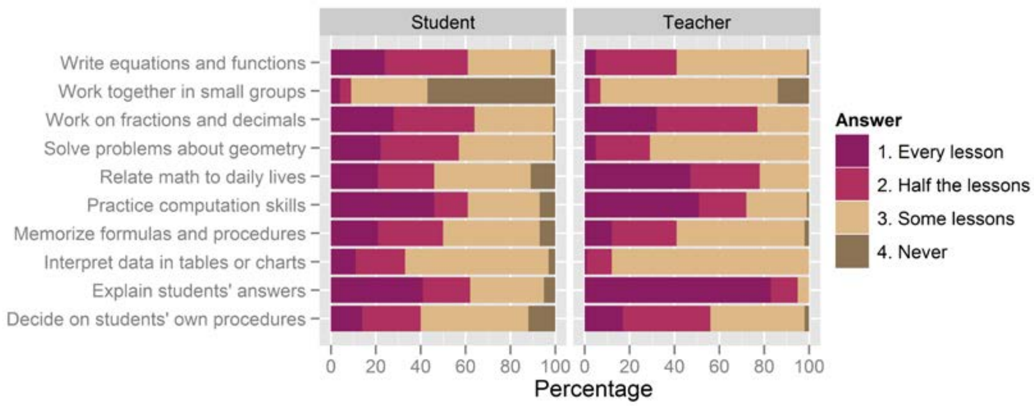

Figure 3. Responses of teachers and students in Hungary.

As shown Figure 3, over 70% of the teachers, in at least half their lessons, asked students practice computation and work on fractions and decimals, which are traditional mathematical activities as well as number content related activities. Similarly, over 60% of students felt that they were involved in these activities in at least half their lessons although students tended to emphasize them less than teachers did. Contrarily, memorization activities were less emphasized by teachers and students than two number content activities, but this was not a neglected activity: In at least half the lessons, about 50% of students felt they spent time memorizing, and about 40% of teachers felt they asked student to memorize formulas and procedures.

Among the reform mathematics activities, teachers were more likely than students to emphasize the following three activities: explaining students' answers, relating mathematics to daily lives, and deciding students' own procedures for solving problems. The first two were remarkably emphasized by teachers as compared to others: In every lesson, 83% of teachers asked students to explain students' answers, and 47% of teachers involved students in the activity related them to daily lives. In contrast, with respect to the content-focused activities on geometry, data analysis, and algebra, students were more likely to emphasize these activities than teachers did. Compared to other activities, students felt these were close to frequent activities, but these were deemphasized activities as perceived by teachers. In addition, both teachers and students tended to deemphasize the small group activity, but there was difference: About 85% of teachers at least sometimes provided students with the small group activity whereas 57% of students felt they were never involved in a small group activity.

Table 6 shows general frequencies of activities in Hungary, frequently versus infrequently. Teachers and students showed significantly different responses about activity frequencies except for small group activities. Especially, obvious was the difference observed in the activity of students' explanations. Teachers were 13 times more likely than students to answer that this activity occurred frequently rather than infrequently. Also, teachers were 4 times more likely than students to respond that the activities related to their daily lives happened frequently. In contrast, with respect to the content-focused activities for geometry and data analysis, students were about 3 or 4 times more likely than teachers to answer that these activities were conducted frequently rather than infrequently.

Table 6
General Frequencies of Activities in Hungary

Activity		Frequently (%)	Infrequently (%)	Chi-square	Odds ratio (T / S)
Practice computation skills	T	72	28	13.31*	1.67
	S	61	39		
Work on fractions and decimals	T	77	23	15.92*	1.81
	S	64	36		
Solve problems about geometry	T	29	71	82.09*	0.30
	S	58	42		
Interpret data in tables or charts	T	12	88	49.86*	0.28
	S	33	67		
Write equations and functions	T	41	59	40.33*	0.45
	S	61	39		
Memorize formulas and procedures	T	42	58	7.59*	0.70
	S	50	50		
Explain students' answers	T	95	5	119.69*	12.83
	S	62	38		
Relate math to daily lives	T	78	22	97.81*	4.12
	S	46	54		
Decide on students' own procedures	T	56	44	22.88*	1.84
	S	41	59		
Work together in small groups	T	7	93	1.36	0.75
	S	9	91		

* $p < .05$.

4.1.4 Japan

As shown in Figure 4, in the traditional mathematics activity, practicing computation and memorization tended to be emphasized by teachers. About 50% of teachers involved students in practicing computation during every lesson, but there were also over 20% of teachers who never engaged in this activity. The data about computation activities for Japanese students, which were not available, were excluded from the analyses in this study. Memorization tended to be similarly emphasized by both teachers and students. However, in the activity about fractions and decimals, teachers and students showed remarkably conflicting perceptions: About 80% of teachers sometimes or never asked conducted these activities whereas about 80% of students engaged in working on fractions and decimals in every lesson.

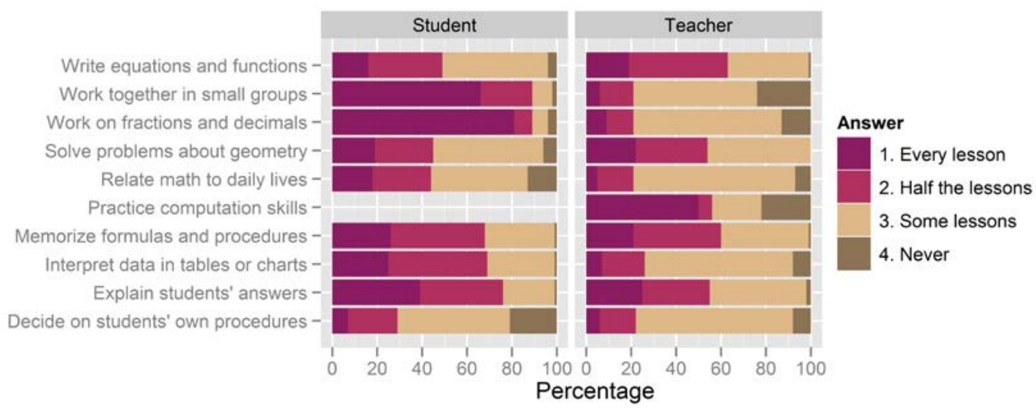

Figure 4. Responses of teachers and students in Japan.

Among the reformed mathematics activities, students were more likely than teachers to emphasize the following activities: explaining students' answers, relating mathematics to daily lives, and deciding students' own procedures for solving problems. Compared to other activities, explaining students' answers was one of most emphasized activities by both teachers and students; the last two activities were not close to frequent activities for either students or teachers.

Among the content-focused and reformed activities, over 70% of teachers sometimes or never asked students to do data analysis activity whereas about 70% of students engaged in this activity in at least half their lesson. Contrarily, teachers emphasized more than students geometry and algebra activities, which were ones strongly emphasized by teachers. In addition, with respect to small group activities, the responses of teachers and students were poles opposites: 80% of teachers sometimes or never involved students in small group activities whereas 80% of students felt they worked together in small groups in at least half their lessons.

Table 7 presents general frequencies of activities in Japan, frequently versus infrequently. Teachers and students showed significantly different perceptions of activity frequencies in all activities. A huge discrepancy between teachers and students was observed in the data analysis content activity, working on fractions and decimals, and working in small groups: Students were about 6 to 30 times more likely than teachers to answer that these occurred frequently rather than infrequently.

Table 7
General Frequencies of Activities in Japan

Activity		Frequently (%)	Infrequently (%)	Chi-square	Odds ratio (T / S)
Practice computation skills	T	56	44	NA	NA
	S	NA	NA		
Work on fractions and decimals	T	21	79	764.84*	0.03
	S	89	11		
Solve problems about geometry	T	54	46	5.98*	1.41
	S	45	55		
Interpret data in tables or charts	T	25	75	177.11*	0.15
	S	69	31		

Table 7 continued

Activity		Frequently (%)	Infrequently (%)	Chi-square	Odds ratio (T / S)
Write equations and functions	T	64	36	16.84*	1.81
	S	49	51		
Memorize formulas and procedures	T	60	40	5.75*	0.71
	S	68	32		
Explain students' answers	T	55	45	47.44*	0.39
	S	76	24		
Relate math to daily lives	T	21	79	40.16*	0.35
	S	43	57		
Decide on students' own procedures	T	22	78	5.82*	0.67
	S	29	71		
Work together in small groups	T	21	79	740.47*	0.03
	S	89	11		

* $p < .05$.

4.1.5 South Korea

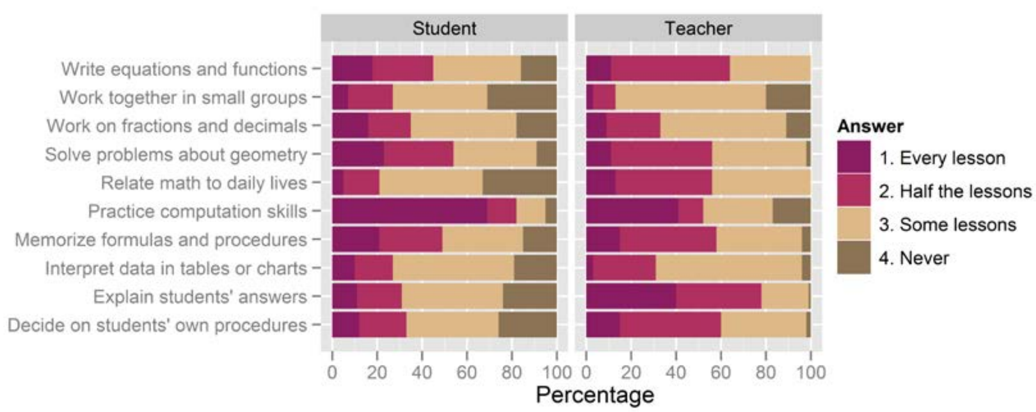

Figure 5. Responses of teachers and students in South Korea.

Among traditional mathematics in Figure 5, practicing computation skills were remarkably emphasized by students compared to other activities. Although teachers emphasized it less than did students, 40% of teachers asked students to practice computation within every lesson. Memorization was less emphasized than the computation, but this belonged to strongly emphasized activities by teachers and students: In at least half the lessons, about 57% of students felts they spent time memorizing, and 67% of teachers felt they involved students in memorizing formulas and procedure.

Among the reform mathematics activities, teachers felt they greatly emphasized the following activities more than students did: explaining students' answers, relating mathematics to daily lives, and deciding students' own procedures. Specially, 78% of teachers felt they asked students to explain students' answers in at least half their lesson, but 69% of students sometimes or never felt they explained their answers. Also, the proportion of students who felt they never related mathematics to daily lives or decided their own procedure for complicated problems answers was about 30%; 98% of teachers at least sometimes provided students with these activities. Compared to these three activities, the content-focused activities for algebra and geometry were further emphasized on the side of students, but were similarly emphasized by teachers.

In addition, Table 8 shows general frequencies of activities in South Korea, frequently versus infrequently. Except for three content focused activities for fraction and decimals, geometry, and data analysis, teachers and students perceived the activity frequencies differently. Especially, with respect to the activity for computation skill, students were 4 times more likely than teachers to answer that this activity occurred frequently rather than infrequently. In contrast, regarding the activities of explaining students' answers and relating math to daily lives, teachers were 8 and 5 times respectively more likely than students to respond that these two activities were employed frequently rather than infrequently.

Table 8
General Frequencies of Activities in South Korea

Activity		Frequently (%)	Infrequently (%)	Chi-square	Odds ratio (T / S)
Practice computation skills	T	52	48	118.93*	0.25
	S	82	18		
Work on fractions and decimals	T	33	67	0.54	0.90
	S	35	65		
Solve problems about geometry	T	56	44	0.60	1.11
	S	54	46		
Interpret data in tables or charts	T	31	69	1.62	1.20
	S	27	73		
Write equations and functions	T	64	36	33.12*	2.20
	S	45	55		
Memorize formulas and procedures	T	58	42	9.06*	1.50
	S	48	52		
Explain students' answers	T	78	22	215.34*	7.73
	S	31	69		
Relate math to daily lives	T	56	44	151.38*	4.75
	S	21	79		
Decide on students' own procedures	T	60	40	67.72*	2.96
	S	33	67		
Work together in small groups	T	13	87	22.71*	0.40
	S	27	73		

* $p < .05$.

4.1.6 England

As shown Figure 6, among the traditional mathematics activities, teachers tended to emphasize practicing computation skills compared to other activities, and students attended in computation practice as much as did teachers. However, on the side of students, practicing computation was not considered as exceptionally emphasized compared to other activities. Also, teachers tended to emphasize less memorization than computation, but students emphasized more memorization than teachers did.

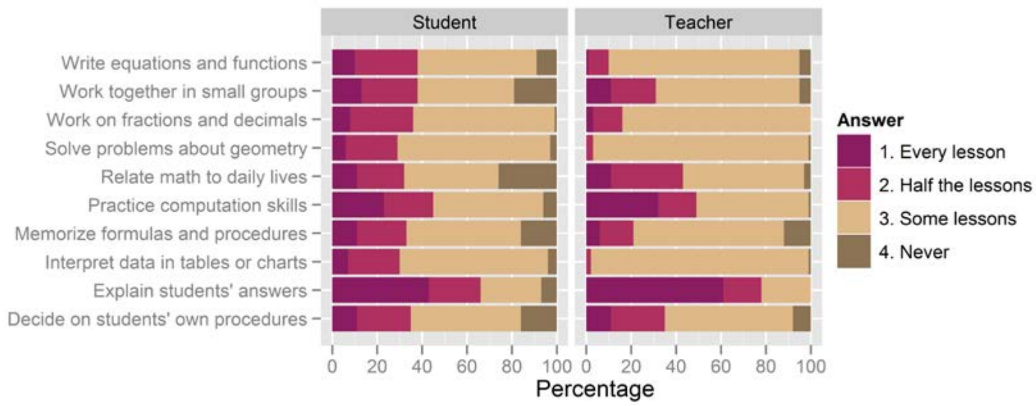

Figure 6. Responses of teachers and students in England.

In comparison with all activities, teachers and students mostly emphasized the activity of explaining students' answers, which was one of the reform mathematics activities. Specially, about 80% of teachers asked students to explain their answers in at least half of the lessons, and furthermore three-quarters of them employed this activity in every lesson. In addition, 96% of teachers at least sometimes provided students with opportunities to relate mathematics to daily lives, whereas 26% of students never attended to this activity in their lessons. In contrast, teachers tended to underemphasize the content-focused activities for geometry, data analysis, and algebra: More than 90% of teachers sometimes or never involved students in these activities.

Table 9
General Frequencies of Activities in England

Activity		Frequently (%)	Infrequently (%)	Chi-square	Odds ratio (T / S)
Practice computation skills	T	49	51	1.01	1.15
	S	46	54		
Work on fractions and decimals	T	15	85	39.41*	0.32
	S	36	64		
Solve problems about geometry	T	3	97	70.61*	0.08
	S	29	71		
Interpret data in tables or charts	T	3	97	76.71*	0.07
	S	30	70		
Write equations and functions	T	9	91	73.91*	0.17
	S	38	62		
Memorize formulas and procedures	T	20	80	14.17*	0.53
	S	33	67		
Explain students' answers	T	79	21	13.92*	1.86
	S	66	34		
Relate math to daily lives	T	43	57	10.13*	1.56
	S	33	67		
Decide on students' own procedures	T	35	65	0.00	0.99
	S	35	65		
Work together in small groups	T	30	70	4.96*	0.72
	S	38	62		

* $p < .05$.

Table 9 presents general frequencies of activities in England, frequently versus infrequently. Statistically, the responses of teachers and students were significantly different with respect to whether an activity occurred frequently or infrequently, except for two activities of practicing computation and deciding students’ own procedures for solving problems. Specially, remarkable differences were observed in three activities for geometry, data analysis, and algebra content: Teachers were 6 to 15 times more likely than students to perceive that these content-focused activities occurred infrequently rather than frequently.

4.2 Classroom Activities between Countries

In the second part, how the countries were different or similar with respect to activities was addressed in terms of traditional mathematics and reform mathematics. To more easily compare general tendencies of the activity frequencies between the six countries, the analyses were based on two categories, frequently and infrequently rather than the original four response categories on the TIMSS questionnaires.

Table 10

Chi-square Tests for Activity Frequencies Between Countries

Activity	Between six countries		Between East Asian countries	
	Teachers χ^2 (5, N=1203)	Students χ^2 (5, N=22890)	Teachers χ^2 (3, N=723)	Students χ^2 (3, N=15378)
Practice computation skills	105.53*	1617.31*[a]	67.64*	1323.40*[b]
Work on fractions and decimals	314.32*	4398.93*	26.41*	3798.35*
Solve problems about geometry	202.02*	866.22*	64.72*	130.35*
Interpret data in tables or charts	87.18*	2080.16*	30.41*	1769.04*
Write equations and functions	205.85*	670.46*	84.06*	162.61*
Memorize formulas and procedures	167.20*	992.51*	125.07*	481.45*
Explain students' answers	171.97*	2669.91*	44.15*	2228.10*
Relate math to daily lives	206.62*	778.64*	71.25*	562.13*
Decide on students' own procedures	130.54*	499.93*	97.15*	472.90*
Work together in small groups	73.97*	7721.60*	19.38*	6107.04*

[a] χ^2 (4, N=18748). [b] χ^2 (3, N=11236).
* $p < .05$.

With respect to whether an activity occurred frequently or infrequently, chi-square tests showed that statistically significant differences in teachers' response between six countries as well as between four East Asian countries at $p < .05$. Also, the students' responses between the six countries as well as between four East Asian countries were significantly different at $p < .05$ (see Table 10).

4.2.1 Traditional mathematics activities

Teachers' responses. Figure 7 shows the percentage of teachers who engaged in the three activities related to traditional mathematics frequently. It was not evident that teachers in four East Asian counties tended to emphasize the traditional mathematics activities more than the non-Asian countries. In other words, depending on activities and countries, it was different whether or not an activity was emphasized or how much an activity was emphasized.

Teachers in Hong Kong most deemphasized practicing computation skills among the all six countries even though Hong Kong belongs to East Asia. In contrast, computation was mostly emphasized by teachers in Chinese Taipei and Hungary, which is categorized as a non-Asian country. Also, although working on fractions and decimals is also number content-focused like the activity of practicing computation, the findings were not the same to the activity of computation. Overall, the countries tended to deemphasize the activity of fractions and decimals except for Hungary in which 77% of teachers frequently asked students to work on fraction and decimals unlike other countries in which 15 to 33% of teachers did. Regarding memorization, Japanese and

Korean teachers mostly emphasized memorization compared to other countries. However, memorization seemed to be far from a frequent activity in the other two East Asian countries, Chinese Taipei, and Hong Kong. Rather, Hungarian teachers involved students in memorization more than those in Chinese Taipei and Hong Kong.

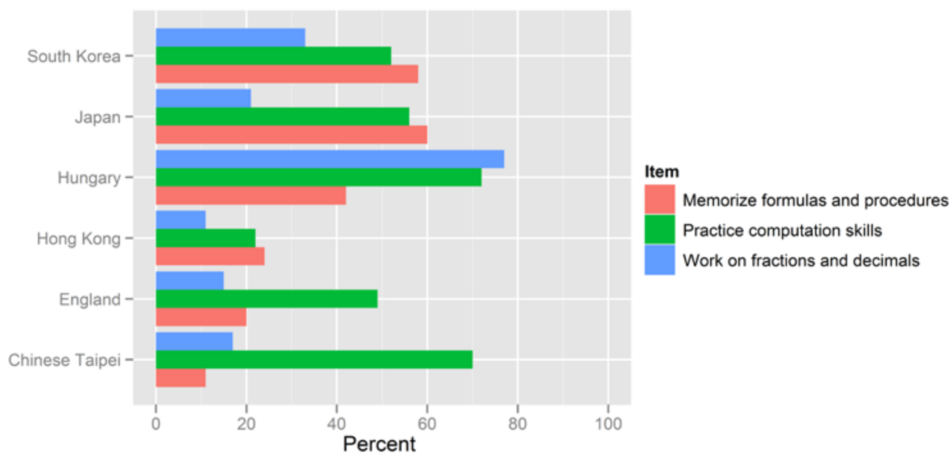

Figure 7. Percentage of teachers asking frequently traditional mathematics activities.

Students' responses. Figure 8 indicates the percentage of students who used the three activities related to traditional mathematics frequently. As teachers' responses, it was not the same whether or not an activity was emphasized or how much an activity was emphasized depending on activities or countries. In other words, it was not evident that East Asian students always emphasized the traditional mathematics activities more than the non-Asian countries.

Specifically, over 80% of Korean students frequently engaged in practicing computation whereas students in Hong Kong were less involved in computation than two non-Asian countries. With respect to the activity about fractions and decimals, it was not evident that students in the two non-Asian countries, England and Hungary, specially deemphasized compared to other East Asian countries although the degree of emphasis by Japanese students were exceptional. In addition, the proportion of students in Hungary who were frequently involved in memorization was similar to those in the three East Asian countries of Chinese Taipei, Hong Kong, and South Korea.

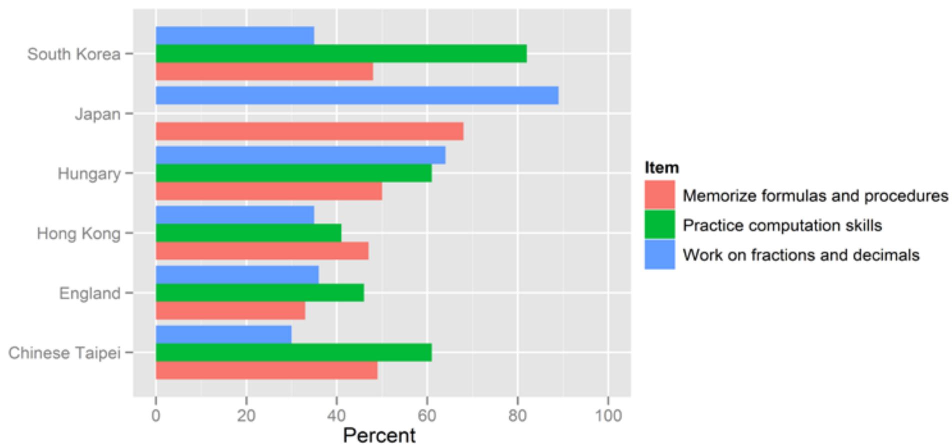

Figure 8. Percentage of students engaged in frequently traditional mathematics activities.

Table 11 presents odds ratios for two countries regarding whether an activity of traditional mathematics was employed frequently or infrequently. In a number of comparisons of two countries, the differences between two countries' teachers were inconsistent with the differences between the two countries' students. For instance, in the activity of practice of computation, teachers in Chinese Taipei were about 8 times more likely than those in Hong Kong to engage students in computation frequently while students in Chinese Taipei were 2.3 times more likely than those in Hong Kong to use computation frequently. Furthermore, in the activity related to fractions and decimals, teachers in Hungary were 12.5 times more likely than those in Japan to use the activities frequently whereas students in Japan were 4.5 times more likely than those in Hungary to use the activities frequently. Also, Korean teachers were 11 times more likely than those in Chinese Taipei to use memorization frequently, but students in the two countries showed no difference in frequency of using memorization.

Table 11
Odds Ratios Between Two Countries for Traditional Mathematics Activities

Odds ratio for countries	Practice computation		Work on fractions and decimals		Memorize formulas and procedures	
	Teachers	Students	Teachers	Students	Teachers	Students
TWN / HKG	8.1	2.3	1.7	0.8	0.4	1.1
TWN / HUN	0.9	1.0	0.1	0.2	0.2	0.9
TWN / JPN	1.8	NA	0.8	0.1	0.1	0.4
TWN / KOR	2.1	0.3	0.4	0.8	0.1	1.0
TWN / ENG	2.4	1.9	1.2	0.7	0.5	2.0
HKG / HUN	0.1	0.5	0.0	0.3	0.5	0.9
HKG / JPN	0.2	NA	0.5	0.1	0.2	0.4
HKG / KOR	0.3	0.2	0.3	1.0	0.2	0.9
HKG / ENG	0.3	0.8	0.7	0.9	1.3	1.8
HUN / JPN	2.0	NA	12.5	0.2	0.5	0.5
HUN / KOR	2.3	0.3	6.7	3.4	0.5	1.1
HUN / ENG	2.7	1.8	17.8	3.2	2.8	2.1
JPN / KOR	1.2	NA	0.5	15.0	1.1	2.3
JPN / ENG	1.3	NA	1.4	14.2	5.8	4.4
KOR / ENG	1.1	5.3	2.6	0.9	5.5	1.9

4.2.2 Reform mathematics activities

Teachers' responses. Figures 9 and 10 show the percentages of teachers who frequently involve students in reform mathematics activities of. It was evident that teachers in all four East Asian counties did not involve students less in all reform mathematics activities than those in the two western countries. Also, it was hard to observed distinct similarities of reformed mathematics activities that all East Asian teachers shared.

Figure 9 presents activities related to the mathematical content of geometry, data analysis, and algebra, which more in line with reform mathematics. Different features were observed within East Asia, and these activities were not always adopted more frequently by teachers in the two western countries than those in four East Asian countries. Rather, these content-focused activities were employed mostly by teachers in Japan and South Korea, showing fairly similar responses with each other, and furthermore teachers in England hardly provided students with opportunities for these activities. Overall, teachers in Hong Kong and Chinese Taipei emphasized these three activities less than those in Japan and South Korea.

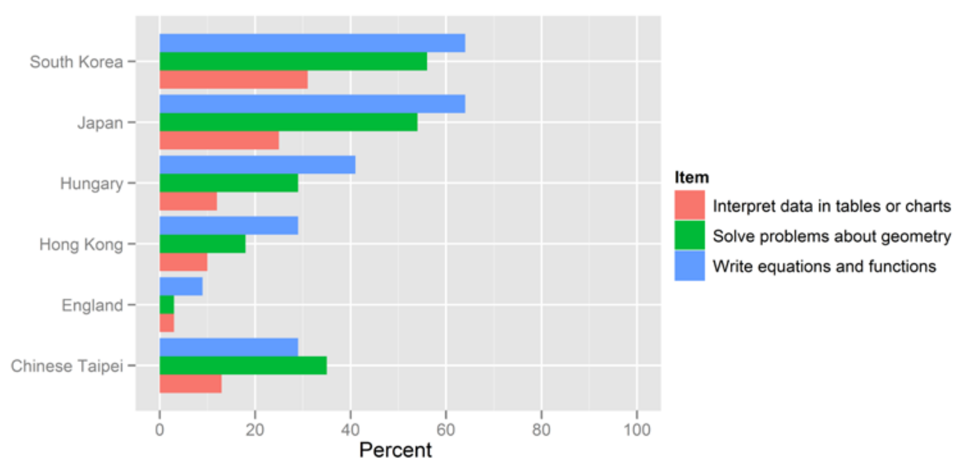

Figure 9. Percentage of teachers asking frequently reformed mathematics activities I.

As shown in Figure 10, four East Asian counties had differences in the frequency of using particular activities. Teachers in Japan, Hong Kong, and Chinese Taipei were less likely to emphasize the four activities than those in Hungary and England, but South Korea was not the case. Among the six countries, South Korean teachers provided the most opportunities for students to decide their own procedures for solving problems. With respect to the activity of explaining students' answers, teachers in Hungary emphasized this activity the most, but a large proportion of Korean teachers also involved students in this activity similar to English teachers. Also, although teachers in Japan, Hong Kong, and Chinese Taipei were less likely to ask students to explain students' answers than other three countries, their proportions were about 50%, so this activity were not necessarily disregarded.

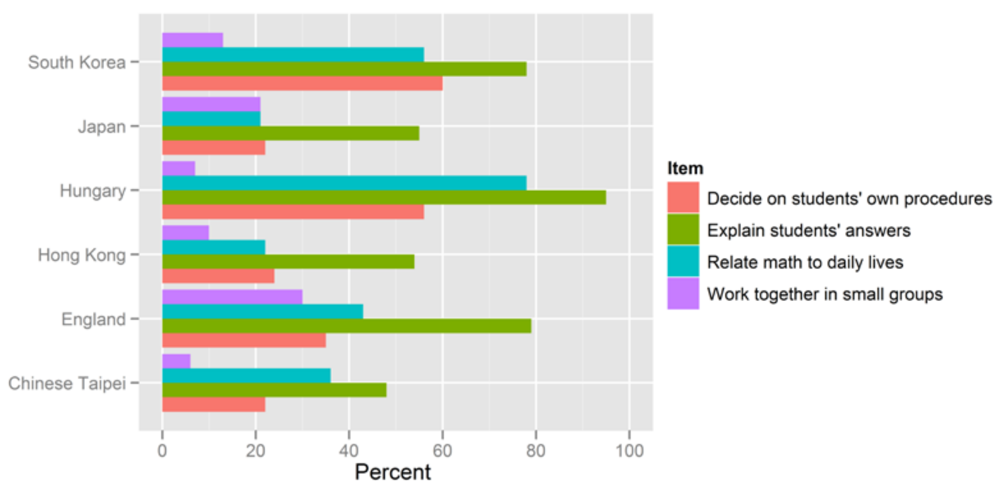

Figure 10. Percentage of teachers asking frequently reformed mathematics activities II.

Students' responses. Figures 11 and 12 illustrate the percentage of students who frequently used the activities related to reform mathematics. As teachers' responses, there were differences within East Asia depending on activities, and distinct features, which only East Asian countries shared in common, were not specifically observed. Also, it was not evident that all East Asian students deemphasized reform mathematics related to activities compared to the western countries.

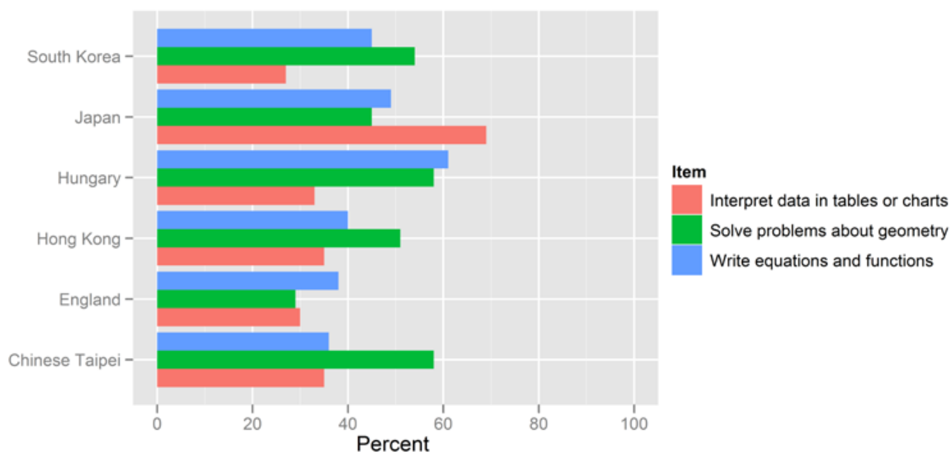

Figure 11. Percentage of students engaged in frequently reformed mathematics activities I.

Figure 11 presents percentages of students who frequently engaged in activities related to mathematical contents of geometry, data analysis, and algebra, which were in line with reform mathematics. Regarding algebra content activities students in South Korea and Japan tend to engage in them more than those in Chinese Taipei and Hong Kong. With respect to data analysis activities except for Japanese students, other countries including two non-Asian countries similarly indicated less emphasis on this activity. Contrarily, 69% of Japanese students frequently participated in data analysis related activity. Lastly, with respect to geometry activities about, over 50% of students in Chinese Taipei, Hong Kong, Hungary, and South Korea were frequently involved in this activity, but English students who engaged in this activity comparatively were less than other countries.

In Figure 12, compared to other countries, Japanese students mostly emphasized students' explanation of activities among the six countries while students in South Korea and Chinese Taipei tended to deemphasize this activity in mathematics lessons. Also, about 90% of Japanese students frequently participated in small group activity whereas students in other countries tended to deemphasize this activity in general. In contrast, with respect to deciding on students' own procedures, Japanese students tended to emphasize them less: 41 to 51 % students frequently decided on their own procedures in Hungary, Hong Kong, and Chinese Taipei while 29 to 35% of students in England, South Korea, and Japan did frequently.

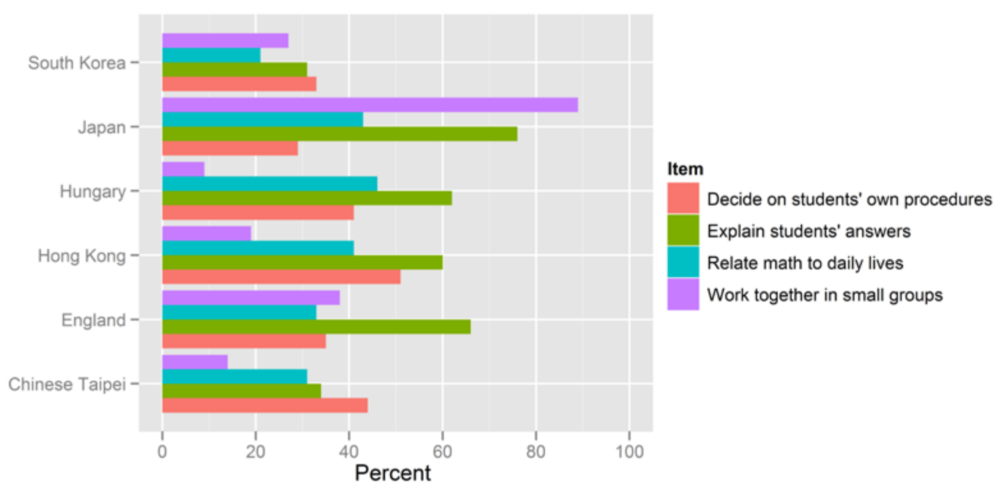

Figure 12. Percentage of students engaged in frequently reformed mathematics activities II.

Tables 12 and 13 indicate odds ratios for two countries regarding whether a reform mathematics activity occurred frequently or infrequently. As traditional mathematics activities, it was observed in numbers of comparisons, but not all that the differences in teachers' responses between two countries were not consistent with the differences in students' responses between the two countries. For instance, with geometry activities, teachers in Chinese Taipei were 16.4 times more likely than those in England to involve in these activities frequently, while students in Chinese Taipei were only 3.3 times more likely than English students to use these activities frequently. Also, Korean teachers were 6 times more likely than Hong Kong teachers to emphasize geometry activities, but students in the two countries showed no difference in frequency of using them. In relating math to daily lives, although students in Hungary and Japan emphasized it similarly, teachers in Hungary were 13.2 times more likely than teachers in Hungary to use these real world activities frequently rather than infrequently.

Table 12
Odds Ratios Between Two Countries for Reformed Mathematics Activities I

Odds ratio for countries	Geometry activity		Data analysis activity		Algebra activity	
	Teachers	Students	Teachers	Students	Teachers	Students
TWN / HKG	2.5	1.3	1.2	1.0	1.0	0.8
TWN / HUN	1.3	1.0	1.0	1.1	0.6	0.4
TWN / JPN	0.5	1.7	0.4	0.2	0.2	0.6
TWN / KOR	0.4	1.2	0.3	1.5	0.2	0.7
TWN / ENG	16.4	3.3	5.1	1.3	4.0	0.9
HKG / HUN	0.5	0.8	0.8	1.1	0.6	0.4
HKG / JPN	0.2	1.3	0.3	0.2	0.2	0.7
HKG / KOR	0.2	0.9	0.3	1.4	0.2	0.8
HKG / ENG	6.6	2.5	4.1	1.2	4.1	1.1

Table 12 Continued

Odds ratio for countries	Geometry activity		Data analysis activity		Algebra activity	
	Teachers	Students	Teachers	Students	Teachers	Students
HUN / JPN	0.3	1.7	0.4	0.2	0.4	1.6
HUN / KOR	0.3	1.2	0.3	1.4	0.4	2.0
HUN / ENG	12.3	3.3	5.0	1.2	7.0	2.6
JPN / KOR	0.9	0.7	0.8	6.1	1.0	1.2
JPN / ENG	35.4	2.0	12.2	5.3	17.5	1.6
KOR / ENG	39.1	2.8	16.0	0.9	17.7	1.3

Table 13

Odds Ratios Between Two Countries for Reformed Mathematics Activities II

Odds ratio for countries	Explaining students' answers		Relating math to daily lives		Deciding on students' own procedures		Working together in small groups	
	Teachers	Students	Teachers	Students	Teachers	Students	Teachers	Students
TWN / HKG	0.8	0.3	1.9	0.6	0.9	0.7	0.6	0.7
TWN / HUN	0.0	0.3	0.2	0.5	0.2	1.2	0.8	1.6
TWN / JPN	0.8	0.2	2.1	0.6	1.0	1.9	0.2	0.0
TWN / KOR	0.3	1.1	0.4	1.7	0.2	1.6	0.4	0.4
TWN / ENG	0.2	0.3	0.7	0.9	0.5	1.5	0.1	0.3
HKG / HUN	0.1	0.9	0.1	0.8	0.3	1.5	1.4	2.4
HKG / JPN	1.0	0.5	1.1	0.9	1.2	2.5	0.4	0.0
HKG / KOR	0.3	3.3	0.2	2.6	0.2	2.1	0.7	0.6
HKG / ENG	0.3	0.7	0.4	1.4	0.6	1.9	0.2	0.4
HUN / JPN	17.1	0.5	13.2	1.1	4.6	1.6	0.3	0.0
HUN / KOR	5.9	3.6	2.8	3.3	0.9	1.4	0.5	0.3
HUN / ENG	5.6	0.8	4.7	1.8	2.3	1.3	0.2	0.2
JPN / KOR	0.3	7.0	0.2	2.9	0.2	0.8	1.8	21.0
JPN / ENG	0.3	1.6	0.4	1.6	0.5	0.8	0.6	12.7
KOR / ENG	0.9	0.2	1.7	0.5	2.7	0.9	0.3	0.6

4.3 Results Summary

Figure 13 presents the summary of findings to help understand, by and large, the patterns of the classroom activities within and between the six countries. Specifically, the emphasis on the ten classroom activities in the six countries was expressed by the gradations of color. In other words, the darker a cell becomes, the larger proportions of respondents who answered that an activity occurred frequently. As shown in Figure 13, it was hard to observe regular patterns of classroom activities mutually represented in all East Asian countries. Also, it was found that teachers and students within a country had different perceptions of an activity in numerous cases.

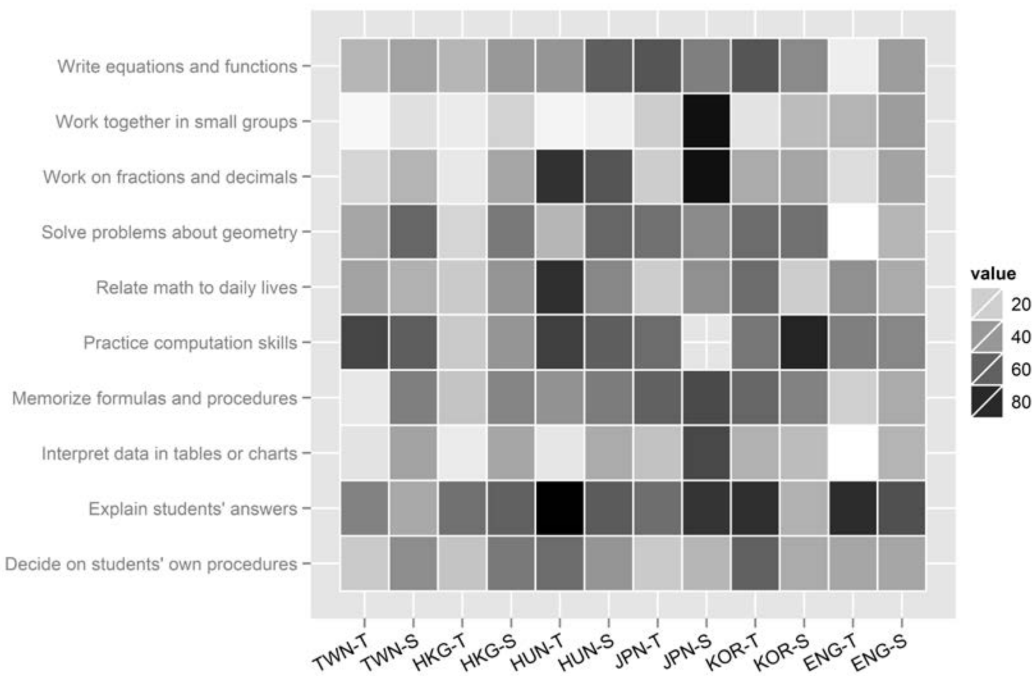

Figure 13. Light and darkness for percentages of respondents emphasizing activities.

5. CONCLUSIONS

This study had three main goals. The first goal was to identify the features of classroom activities as one facet of classroom practices in four East Asian countries. Second, this study aimed to determine whether East Asian countries share similarities of classroom activities, which are differentiated from the West in educational practice. The third goal was to verify whether or not the perceptions of classroom activities between teachers and students within a country are consistent with each other. In this section, the results are discussed with conclusions. Following these, implications are presented and suggestions for the further research are given.

5.1 Discussions and Conclusions

This study examined the ten classroom activities in East Asia countries, placed at the top of mathematics performance. Stevenson and Stigler (1992) believed that the gap in academic achievement is generated from the difference of learning experience in classrooms. Along with their view, it was expected that in the aspect of classroom activities of mathematics, the four East Asian countries, Chinese Taipei, Hong Kong, Japan, and South Korea, shared distinct features in common, which can explain their high academic outcomes in mathematics. Specifically, the classroom activities in East Asia can be discussed within the aspects of the culture, whether or not it is East Asian, and the math educational trend, which is traditional or reform.

This study aimed to verify whether there were unique trends of classroom activities in the four East Asian countries, compared to two non-Asian countries. The findings are not in accordance with the opinions of Schmidt (1996) and Hoang (2009), who believed that strong cultural components exist in classroom practice. This study showed that there were differences in frequencies of each classroom activity within the four East Asia countries as well as between the all six countries including two non-Asian countries in all ten activities. Of course, depending on activities, two or three out of East Asian countries showed a similar tendency with classroom activities. However, there were not strong common characteristics, which all four countries in East Asia together remarkably shared. Rather, it was also observed that a country in East Asia was more similar to a country in non-Asia than the rest of the East Asian countries on some activities.

Therefore, although this study did not consider various aspects of classroom practice, but focused on only classroom activities, the findings seem to differ from the view of Leung (2001), which is that East Asian countries have their common distinctive features reflecting their region's cultural values.

Furthermore, the perspective of East Asia versus the West in education can be extended to two different philosophies of mathematics education: traditional mathematics versus reform mathematics. The findings of this study indicated that some activities, but not all, considered as traditional mathematics tended to be conducted frequently in the majority of East Asian countries. However, this was not necessarily the case for only East Asia, and there were instances where even an East Asian country did not especially emphasize or deemphasized traditional mathematics activities. In addition, the activities related to reform mathematics were actualized in East Asian classroom as the conclusion of Lee's study (1998). Compared to traditional mathematics activities within a country in East Asia, the activities of reform mathematics were not more likely to be deemphasized. Also, in each reform mathematics activity, all East Asian countries did not necessarily emphasize them less than the two non-Asian countries.

The results as above were inconsistent in stereotyping East Asian education mentioned in the previous studies (Leung, 2001; Stevenson & Stigler, 1992): East Asia focuses on "rote learning" based on traditional teaching and learning such as memorization and repeated basic skills. Thus, it is not reasonable that East Asian education is easily connected with traditional teaching and learning in the abstract.

The features of classroom activities observed in four East Asian countries are related to the issue of using the term 'East Asia' to describe educational practice in East Asia and furthermore to compare it to the Western education. In this study, the term 'East Asian' cannot express clearly any representative features regarding classroom activities of mathematics lessons for the whole of East Asia. In other words, the term 'East Asia' cannot represent an individual country in East Asia because there were differences within East Asian countries as Wang and Lin (2005) insisted. In this respect, the results of this study serve as evidence to support previous studies, which problematized or were concerned about the ambiguous term 'East Asia' (Huang & Leung, 2004; Li & Shimizu, 2009; Wang & Lin, 2005; Wong, 2009). To sum up, considering classroom activities of four East Asian countries, which were carried out diversely, one word, East Asian style, is regarded as over-generalized.

Lastly, it was found that there were discrepancies in perceptions between students and teachers about activities within a country. Specifically, in some cases, teachers and students showed only degrees of differences in regard to the same opinions about an activity, but there were sometimes instances where the perceptions of an activity between teachers and students were completely opposite. This finding is supported by previous research studies (Biemans et al., 1999; Brok et al., 2006; Hamilton & Martinez, 2007), indicating that the opinions of two sides, namely teachers and students, did not always agree.

In addition, the discrepancies between teachers and students within a country led to another inconsistency. In the comparison between any two countries out of the six countries with respect to an activity, it was found that the differences between teachers of two countries was inconsistent with those between students. In other words, any two countries might be quite similar with respect to teachers while the two countries might be completely different with respect to students and vice versa. Therefore, as the suggestions of the previous studies (Biemans et al., 1999; Brok et al., 2006), it is important to consider students' eyes, along with teachers' views, toward classroom practices such as classroom activities in order to provide and obtain accurate information in the study for educational practice.

5.2 Implications and Suggestions for Further Study

The evidence from this study suggests that an individual country in East Asia should not be generalized or simplified by its geographical location, East Asia. The results of this study indicate that although all four East Asian countries are placed on the top of mathematics performance, there are no distinct common features, which can explain their high achievement among them using the aspect of classroom activities. The reason might be that teaching and learning in East Asia are different depending on each country, which has developed and changed its educational practice to fit its own educational situation. Thus, it seems that their major contributors to high achievement might be different depending on the countries although students in all the countries have achieved high levels of mathematics competency. Moreover, it is possible that depending on countries, classroom practice, such as classroom activities, is not the influential factor, and instead other factors, such as individual backgrounds, teacher quality, or educational policy, might strongly have an effect on achievement. Thus, some features observed in a high achieving country might not be solutions for a low achieving country. In this respect, educators must be careful not to superficially compare educational aspects between countries, jump to conclusions, and rashly introduce new approaches.

However, more research is needed on whether there are any similarities in teaching and learning between East Asian countries through examining various facets of classroom practice except for classroom activities. Besides, Gage (1978; as cited in Hiebert & Grouws, 2007, p. 398) said that "qualitative approaches reveal what is possible and quantitative approaches demonstrate what is probable." This study focused on the frequency of the activities based on quantitative analyses, but the frequency of an activity does not specifically but generally explain the characteristics of the activity.

Thus, further work needs to be done to reveal how the activities were conducted differently in detail based on qualitative studies, which can help understanding how teaching works to facilitate learning in detail (Maxwell, 2004).

Second, this study found discrepancies of perceptions between teachers and students regarding classroom activities. In other words, the types of activities that teachers feel they asked students engage in are in discord with the types of activities students feel they participated in during their classroom mathematics. These findings are not in the line with the idea: students learn what teachers plan as they participate in academic tasks (Kaur, 2010), or mathematics tasks mean what students were asked by teachers during their lessons (Mason & Johnson-Wilder, 2006). If so, it makes sense that what teachers emphasize tends to be consistent with what students carry out.

Thus, it is necessary to think about this phenomenon in depth such as what it means and why it occurs. This phenomenon can be explained as following: what teachers emphasize in classroom cannot be conveyed to students, or students might not grasp well what teachers ask in their lessons. Another possibility is that students do not tend to follow what teachers ask uniformly to all students, and instead, they are involved in the activities which they need or want. In this respect, differences in perceptions regarding instruction between teachers and students might be related to the teaching and learning.

Therefore, a future study investigating the correlation of the discrepancies of perceptions between teachers and students with academic outcomes would be very interesting. If the differences of perceptions between students and teachers make an impact on students' academic achievement, it would be of value for educators to understand and explain the gaps in achievement within as well as between countries.

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APPENDIX A

THE GOALS IN THE CONTENT STANDARDS OF NCTM (NCTM, 2000)

Mathematical Content	Learning Goals
Number and operations	• Understand numbers, ways of representing numbers, relationships among numbers, and number systems • Understand meanings of operations and how they relate to one another • Compute fluently and make reasonable estimates.
Algebra	• Understand patterns, relations, and functions • Represent and analyze mathematical situations and structures using algebraic symbols • Use mathematical models to represent and understand quantitative relationships • Analyze change in various contexts.
Geometry	• Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships • Specify locations and describe spatial relationships using coordinate geometry and other representational systems • Apply transformations and use symmetry to analyze mathematical situations • Use visualization, spatial reasoning, and geometric modeling to solve problems.
Measurement	• Understand measurable attributes of objects and the units, systems, and processes of measurement • Apply appropriate techniques, tools, and formulas to determine measurements
Data analysis and probability	• Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them • Select and use appropriate statistical methods to analyze data • Develop and evaluate inferences and predictions that are based on data • Understand and apply basic concepts of probability

APPENDIX B

TIMSS 2007 QUESTIONNAIRE ABOUT CLASSROOM ACTIVITIES

1. Student Questionnaire

Mathematics in School (Continued)

11

How often do you do these things in your mathematics lessons?

*Fill in **one** oval for each line*

		Every or almost every lesson	About half the lessons	Some lessons	Never
a)	We practice adding, subtracting, multiplying, and dividing without using a calculator	①	②	③	④
b)	We work on fractions and decimals	①	②	③	④
c)	We solve problems about geometric shapes, lines and angles	①	②	③	④
d)	We interpret data in tables, charts, or graphs	①	②	③	④
e)	We write equations and functions to represent relationships	①	②	③	④
f)	We memorize formulas and procedures	①	②	③	④
g)	We explain our answers	①	②	③	④
h)	We relate what we are learning in mathematics to our daily lives	①	②	③	④
i)	We decide on our own procedures for solving complex problems	①	②	③	④
j)	We review our homework	①	②	③	④
k)	We listen to the teacher give a lecture-style presentation	①	②	③	④
l)	We work problems on our own	①	②	③	④
m)	We work together in small groups	①	②	③	④
n)	We begin our homework in class	①	②	③	④
o)	We have a quiz or test	①	②	③	④
p)	We use calculators	①	②	③	④
q)	We use computers	①	②	③	④

Page 12 Grade 8 Student Questionnaire

2. Teacher Questionnaire

Teaching Mathematics to the TIMSS Class

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In teaching mathematics to the students in the TIMSS class, how often do you usually ask them to do the following?

*Fill in **one** circle for each row*

	Every or almost every lesson	About half the lessons	Some lessons	Never
a) Practice adding, subtracting, multiplying, and dividing without using a calculator	①	②	③	④
b) Work on fractions and decimals	①	②	③	④
c) Use knowledge of the properties of shapes, lines and angles to solve problems	①	②	③	④
d) Interpret data in tables, charts or graphs	①	②	③	④
e) Write equations and functions to represent relationships	①	②	③	④
f) Memorize formulas and procedures	①	②	③	④
g) Apply facts, concepts and procedures to solve routine problems	①	②	③	④
h) Explain their answers	①	②	③	④
i) Relate what they are learning in mathematics to their daily lives	①	②	③	④
j) Decide on their own procedures for solving complex problems	①	②	③	④
k) Work on problems for which there is no immediately obvious method of solution	①	②	③	④
l) Work together in small groups	①	②	③	④

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In your view, to what extent do the following limit how you teach the TIMSS class?

*Fill in **one** circle for each row*

	Not applicable	Not at all	A little	Some	A lot
Students					
a) Students with different academic abilities	①	②	③	④	⑤
b) Students who come from a wide range of backgrounds (e.g., economic, language)	①	②	③	④	⑤
c) Students with special needs (e.g., hearing, vision, speech impairment, physical disabilities, mental or emotional/psychological impairment)	①	②	③	④	⑤
d) Uninterested students	①	②	③	④	⑤
e) Disruptive students	①	②	③	④	⑤
Resources					
f) Shortage of computer hardware	①	②	③	④	⑤
g) Shortage of computer software	①	②	③	④	⑤
h) Shortage of support for using computers	①	②	③	④	⑤
i) Shortage of textbooks for student use	①	②	③	④	⑤
j) Shortage of other instructional equipment for students' use	①	②	③	④	⑤
k) Shortage of equipment for your use in demonstrations and other exercises	①	②	③	④	⑤
l) Inadequate physical facilities	①	②	③	④	⑤
m) High student/teacher ratio	①	②	③	④	⑤

APPENDIX C

THE RESPONSES' PROPORTIONS OF TEACHERS AND STUDENTS

1. Chinese Taipei

Activity		EL (%)	HL (%)	SL (%)	N (%)
PCK	T	67.8	2.1	19.6	10.5
	S	57.2	3.7	15.7	23.4
WFD	T	6.3	11.2	76.9	5.6
	S	13.6	16.3	62.7	7.5
SPG	T	13.3	21.7	65.0	0.0
	S	26.5	31.1	35.2	7.2
IDTC	T	5.6	7.0	82.5	4.9
	S	14.7	20.8	55.2	9.3
WEF	T	7.0	21.7	67.8	3.5
	S	12.4	23.2	55.2	9.1
MFP	T	2.8	8.4	81.8	7.0
	S	21.5	27.1	41.7	9.7
ESA	T	25.9	21.7	51.7	0.7
	S	13.7	19.9	47.6	18.9
RML	T	11.9	23.8	64.3	0.0
	S	10.8	19.7	51.6	17.8
DSP	T	8.4	13.3	75.5	2.8
	S	17.8	26.2	42.0	13.9
WTG	T	2.8	2.8	62.9	31.5
	S	4.9	8.8	36.2	50.1

Note. EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

2. Hong Kong

Activity		EL (%)	HL (%)	SL (%)	N (%)
PCK	T	13.3	8.9	58.5	19.3
	S	21.0	19.9	43.5	15.6
WFD	T	1.5	9.6	83.0	5.9
	S	11.8	22.9	59.2	6.1
SPG	T	0.0	17.8	82.2	0.0
	S	12.9	38.0	46.7	2.4
IDTC	T	0.0	10.4	81.5	8.1
	S	7.3	27.4	61.1	4.2
WEF	T	3.0	25.9	64.4	6.7
	S	12.8	27.4	52.7	7.1
MFP	T	6.7	17.8	68.1	7.4
	S	17.8	29.1	44.6	8.4
ESA	T	21.5	32.6	45.9	0.0
	S	28.6	31.2	35.6	4.7
RML	T	1.5	20.7	72.6	5.2
	S	13.1	27.8	48.6	10.6
DSP	T	3.7	20.7	69.6	5.9
	S	17.2	34.1	42.2	6.4
WTG	T	2.2	7.4	70.4	20.0
	S	4.9	14.3	44.9	35.9

Note. EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

3. Hungary

Activity		EL (%)	HL (%)	SL (%)	N (%)
PCK	T	50.8	21.2	26.9	1.2
	S	45.6	14.9	32.2	7.3
WFD	T	31.5	45.0	23.5	0.0
	S	27.8	36.6	34.9	0.8
SPG	T	4.6	24.2	71.2	0.0
	S	22.7	35.0	41.8	0.5
IDTC	T	1.2	11.2	87.7	0.0
	S	10.8	22.6	63.7	2.9
WEF	T	5.0	36.2	57.7	1.2
	S	24.4	36.7	36.8	2.1
MFP	T	12.3	29.2	56.5	1.9
	S	21.1	29.3	42.4	7.2
ESA	T	83.1	12.3	4.6	0.0
	S	41.1	20.6	33.5	4.8
RML	T	46.9	31.2	21.5	0.4
	S	20.8	25.6	42.8	10.8
DSP	T	17.3	38.5	41.9	2.3
	S	14.2	26.5	47.5	11.8
WTG	T	1.9	5.0	78.8	14.2
	S	4.2	4.8	34.1	56.8

Note. EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

4. Japan

Activity		EL (%)	HL (%)	SL (%)	N (%)
PCK	T	50.5	5.7	21.7	22.2
	S	NA	NA	NA	NA
WFD	T	8.5	12.3	66.0	13.2
	S	81.0	8.0	6.8	4.2
SPG	T	22.2	31.6	45.8	0.5
	S	19.1	26.1	49.0	5.8
IDTC	T	6.6	18.9	66.5	8.0
	S	25.4	44.1	29.7	0.8
WEF	T	19.3	44.3	35.8	0.5
	S	16.2	33.0	47.3	3.5
MFP	T	21.2	38.7	38.7	1.4
	S	25.5	42.3	31.1	1.1
ESA	T	25.0	29.7	43.4	1.9
	S	39.2	36.6	22.9	1.4
RML	T	4.7	16.5	71.7	7.1
	S	17.5	25.8	43.3	13.4
DSP	T	5.7	16.0	69.8	8.5
	S	7.4	22.0	49.8	20.8
WTG	T	6.1	14.6	54.7	24.5
	S	65.8	22.8	9.7	1.7

Note. EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

5. South Korea

Activity		EL (%)	HL (%)	SL (%)	N (%)
PCK	T	40.8	11.6	30.9	16.7
	S	68.5	13.1	13.2	5.1
WFD	T	9.0	23.6	56.2	11.2
	S	16.4	18.5	46.5	18.5
SPG	T	11.2	45.1	42.1	1.7
	S	22.9	30.7	37.0	9.4
IDTC	T	3.4	27.5	64.8	4.3
	S	9.9	17.1	53.6	19.3
WEF	T	11.2	52.8	36.1	0.0
	S	17.7	27.0	38.8	16.6
MFP	T	15.5	42.9	37.8	3.9
	S	20.6	27.6	36.2	15.6
ESA	T	39.5	38.2	21.5	0.9
	S	10.7	20.3	45.2	23.8
RML	T	12.9	42.9	44.2	0.0
	S	5.4	15.6	46.4	32.6
DSP	T	15.0	44.6	38.2	2.1
	S	11.8	21.5	41.2	25.5
WTG	T	2.6	10.3	67.0	20.2
	S	7.3	19.7	41.8	31.2

Note. EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; ; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

6. England

Activity		EL (%)	HL (%)	SL (%)	N (%)
PCK	T	32.3	16.8	50.5	0.5
	S	23.0	22.6	48.6	5.8
WFD	T	2.7	12.7	84.5	0.0
	S	8.6	27.7	63.0	0.8
SPG	T	0.0	3.2	96.4	0.5
	S	6.4	22.9	67.6	3.1
IDTC	T	0.5	2.3	96.8	0.5
	S	10.3	27.5	53.1	9.2
WEF	T	0.5	8.6	85.5	5.5
	S	24.4	36.7	36.8	2.1
MFP	T	5.9	14.5	67.3	12.3
	S	10.4	22.2	51.0	16.4
ESA	T	61.4	17.3	21.4	0.0
	S	43.3	23.1	26.6	6.9
RML	T	10.9	32.3	53.6	3.2
	S	11.4	21.4	41.8	25.5
DSP	T	11.4	23.6	56.8	8.2
	S	11.1	24.1	49.1	15.8
WTG	T	10.5	20.0	64.1	5.5
	S	13.4	24.6	43.1	19.0

Note. EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

APPENDIX D

THE CHI-SQUARE TESTS FOR RESPONDENTS AND FOUR CATEGORIES

1. Chinese Taipei

Activity		SR in EL	SR in HL	SR in SL	SR in N	$\chi^2(3)$, *p*	V
PCK	T	1.6	-1.0	1.1	-3.1	15.04, .002	0.06
	S	-0.3	0.2	-0.2	0.6		
WFD	T	-2.3	-1.5	2.1	-0.8	12.78, .005	0.06
	S	0.4	0.3	-0.4	0.2		
SPG	T	-3.0	-2.0	5.7	-3.1	57.293, .000	0.12
	S	0.6	0.4	-1.1	0.6		
IDTC	T	-2.8	-3.5	4.2	-1.7	41.69, .000	0.10
	S	0.5	0.7	-0.8	0.3		
WEF	T	-1.8	-0.4	1.9	-2.2	12.28, .006	0.06
	S	0.4	0.1	-0.4	0.4		
MFP	T	-4.7	-4.2	7.0	-1.0	93.85, .000	0.16
	S	0.9	0.8	-1.4	0.2		
ESA	T	3.7	0.5	0.7	-4.9	40.20, .000	0.10
	S	-0.7	-0.1	-0.1	1.0		
RML	T	0.4	1.0	2.0	-5.0	31.01, .000	0.09
	S	-0.1	-0.2	-0.4	1.0		
DSP	T	-2.6	-2.9	5.9	-3.5	64.30, .000	0.13
	S	0.5	0.6	-1.1	0.7		
WTG	T	-1.1	-2.4	5.1	-3.0	43.28, .000	0.11
	S	0.2	0.5	-1.0	0.6		

Note. SR = standardized residual; EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

2. Hong Kong

Activity		SR in EL	SR in HL	SR in SL	SR in N	$\chi^2(3)$, *p*	V
PCK	T	-1.9	-2.8	2.5	1.0	19.45, .000	0.08
	S	0.4	0.6	-0.5	-0.2		
WFD	T	-3.4	-3.1	3.4	-0.1	34.61, .000	0.10
	S	0.7	0.6	-0.7	0.0		
SPG	T	-4.1	-3.7	5.7	-1.8	68.87, .000	0.14
	S	0.8	0.7	-1.1	0.4		
IDTC	T	-3.1	-3.7	2.9	2.1	37.06, .000	0.10
	S	0.6	0.7	-0.6	-0.4		
WEF	T	-3.1	-0.3	1.8	-0.2	13.66, .003	0.06
	S	0.6	0.1	-0.4	0.0		
MFP	T	-3.0	-2.4	3.9	-0.4	31.01, .000	0.09
	S	0.6	0.5	-0.8	0.1		
ESA	T	-1.5	0.3	1.9	-2.5	12.48, .006	0.06
	S	0.3	-0.1	-0.4	0.5		
RML	T	-3.6	-1.5	3.8	-1.9	34.87, .000	0.10
	S	0.7	0.3	-0.8	0.4		
DSP	T	-3.7	-2.6	4.7	-0.2	43.73, .000	0.11
	S	0.7	0.5	-0.9	0.0		
WTG	T	-1.4	-2.1	4.2	-3.0	33.97, .000	0.10
	S	0.3	0.4	-0.8	0.6		

Note. SR = standardized residual; EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

3. Hungary

Activity		SR in EL	SR in HL	SR in SL	SR in N	$\chi^2(3)$, *p*	V
PCK	T	1.2	2.4	-1.4	-3.5	22.97, .000	0.08
	S	-0.3	-0.6	0.4	0.9		
WFD	T	1.1	2.1	-2.9	-1.4	17.20, .001	0.07
	S	-0.3	-0.5	0.8	0.4		
SPG	T	-5.9	-2.8	6.7	-1.1	94.40, .000	0.15
	S	1.5	0.7	-1.8	0.3		
IDTC	T	-4.6	-3.7	4.5	-2.7	65.96, .000	0.13
	S	1.2	1.0	-1.2	0.7		
WEF	T	-6.1	-0.1	5.1	-1.0	68.37, .000	0.13
	S	1.6	0.0	-1.3	0.3		
MFP	T	-2.9	0.0	3.2	-3.0	30.25, .000	0.09
	S	0.8	0.0	-0.8	0.8		
ESA	T	9.6	-2.8	-7.8	-3.4	183.109, .000	0.21
	S	-2.5	0.7	2.0	0.9		
RML	T	8.3	1.6	-5.0	-4.9	129.58, .000	0.18
	S	-2.2	-0.4	1.3	1.3		
DSP	T	1.3	3.5	-1.2	-4.3	35.79, .000	0.09
	S	-0.3	-0.9	0.3	1.1		
WTG	T	-1.7	0.1	11.1	-8.7	216.02, .000	0.23
	S	0.4	0.0	-2.9	2.3		

Note. SR = standardized residual; EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

4. Japan

Activity		SR in EL	SR in HL	SR in SL	SR in N	$\chi^2(3)$, *p*	V
PCK	T	NA	NA	NA	NA	NA	NA
	S	NA	NA	NA	NA		
WFD	T	-11.4	2.0	26.4	5.7	910.33, .000	0.46
	S	2.6	-0.5	-6.0	-1.3		
SPG	T	1.0	1.5	-0.6	-3.1	14.06, .003	0.06
	S	-0.2	-0.3	0.1	0.7		
IDTC	T	-5.3	-5.3	9.1	9.1	232.45, .000	0.23
	S	1.2	1.2	-2.1	-2.1		
WEF	T	1.1	2.7	-2.3	-2.3	19.95, .000	0.07
	S	-0.2	-0.6	0.5	0.5		
MFP	T	-1.2	-0.8	1.9	0.4	5.95, .114	0.04
	S	0.3	0.2	-0.4	-0.1		
ESA	T	-3.2	-1.6	5.8	0.6	49.22, .000	0.13
	S	0.7	0.4	-1.3	-0.1		
RML	T	-4.3	-2.5	5.9	-2.4	35.05, .000	0.09
	S	1.0	0.6	-1.3	0.5		
DSP	T	-0.9	-1.8	3.9	-3.8	35.79, .000	0.09
	S	0.2	0.4	-0.9	0.9		
WTG	T	-10.4	-2.4	18.1	18.8	836.24, .000	0.44
	S	2.4	0.5	-4.1	-4.3		

Note. SR = standardized residual; EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

5. South Korea

Activity		SR in EL	SR in HL	SR in SL	SR in N	$\chi^2(3)$, *p*	V
PCK	T	-4.9	-0.6	6.8	7.0	126.27, .000	0.17
	S	1.2	0.1	-1.6	-1.7		
WFD	T	-2.7	1.7	2.0	-2.5	21.60, .000	0.07
	S	0.6	-0.4	-0.5	0.6		
SPG	T	-3.6	3.7	1.2	-3.7	44.33, .000	0.10
	S	0.9	-0.9	-0.3	0.9		
IDTC	T	-3.0	3.5	2.2	-5.0	54.86, .000	0.11
	S	0.7	-0.8	-0.5	1.2		
WEF	T	-2.3	7.0	-0.6	-6.0	96.33, .000	0.15
	S	0.5	-1.7	0.2	1.4		
MFP	T	-1.7	4.1	0.4	-4.4	41.47, .000	0.10
	S	0.4	-1.0	-0.1	1.0		
ESA	T	11.9	5.6	-5.2	-7.0	261.96, .000	0.25
	S	-2.8	-1.3	1.2	1.7		
RML	T	4.5	9.6	-0.5	-8.5	193.91, .000	0.21
	S	-1.1	-2.3	0.1	2.0		
DSP	T	1.4	7.0	-0.7	-6.9	103.92, .000	0.15
	S	-.3	-1.7	0.2	1.6		
WTG	T	-2.6	-3.1	5.5	-2.9	58.14, .000	0.12
	S	0.6	0.7	-1.3	0.7		

Note. SR = standardized residual; EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

6. England

Activity		SR in EL	SR in HL	SR in SL	SR in N	$\chi^2(3)$, *p*	V
PCK	T	2.7	-1.7	0.4	-3.2	21.59, .000	0.07
	S	-0.7	0.4	-0.1	0.8		
WFD	T	-2.8	-4.0	3.8	-1.3	42.65, .0008	0.10
	S	0.7	1.0	-0.9	0.3		
SPG	T	-3.6	-5.9	4.8	-2.1	80.84, .000	0.14
	S	0.9	1.4	-1.2	0.5		
IDTC	T	-3.5	-6.3	5.3	-2.6	91.86, .000	0.15
	S	0.8	1.5	-1.3	0.6		
WEF	T	-4.4	-5.1	6.1	-1.7	91.40, .000	0.15
	S	1.1	1.2	-1.5	0.4		
MFP	T	-2.0	-2.3	3.2	-1.4	22.53, .000	0.08
	S	0.5	0.6	-0.8	0.3		
ESA	T	3.8	-1.7	-1.4	-3.8	35.67, .000	0.10
	S	-0.9	0.4	0.3	0.9		
RML	T	-0.2	3.2	2.6	-6.3	60.68, .000	0.12
	S	0.0	-0.8	-0.6	1.5		
DSP	T	0.1	-0.1	1.5	-2.7	10.29, .016	0.05
	S	0.0	0.0	-0.4	0.7		
WTG	T	-1.1	-1.3	4.4	-4.4	44..81, .000	0.11
	S	0.3	0.3	-1.1	1.1		

Note. SR = standardized residual; EL = (almost) every lesson; HL = about half the lessons; SL = some lessons; N = Never; PCK = Practice computation skills; WFD = Work on fractions and decimals; SPG = Solve problems about geometry; IDTC = Interpret data in tables or charts; WEF = Write equations and functions; MFP = Memorize formulas and procedures; ESA = Explain students' answers; RML = Relate math to daily lives; DSP = Decide on students' own procedures; WTG = Work together in small groups.

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